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# Energy Use in Penn's Student Housing and Techniques to Achieve Energy Reduction

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Using data collected from an online survey and energy audits, the thesis has numerous findings. First, electricity consumption, as measured by individual energy audits, is dominated by the refrigerator making up over a majority of total electricity consumed. Wasted electricity is minimal making up only 1% of total electricity. Additionally, survey respondents indicated that students were willing to support sustainable initiatives on campus. Lastly, according to survey results, the initiatives that could be most effective in lowering electricity use require the individual metering of rooms to track consumption. Several of the suggested techniques to lower energy consumption include: 1) encourage the use of or provide energy efficient refrigerators, 2) highlight preexisting university initiatives, 3) start educational campaigns for students on energy conservation, 4) facilitate energy conservation through subsidies, and 5) improve the design of the rooms to ensure energy conservation. By implementing some or all of these techniques, it is likely there will be a reduction of electricity in student housing.

**Keywords**
Urban Studies; University of Pennsylvania; energy use; student housing

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**Abstract**

Institutions of higher education have a profound role in the battle against climate change. From making large purchases to educating thousands of people in a localized setting, universities and colleges can truly make a difference. While instituting large-scale changes are difficult and can take years, small initiatives are necessary to achieve to the overarching goal of creating a sustainable university. The purpose of this thesis is to look at electricity consumption in student housing and specific techniques to achieve energy reduction at this level of the university. The paper seeks to advise the University of Pennsylvania's Facilities and Real Estate Services and the Sustainability Team at Penn on potential techniques to reduce energy in student housing on campus.

Using data collected from an online survey and energy audits, the thesis has numerous findings. First, electricity consumption, as measured by individual energy audits, is dominated by the refrigerator making up over a majority of total electricity consumed. Wasted electricity is minimal making up only 1% of total electricity. Additionally, survey respondents indicated that students were willing to support sustainable initiatives on campus. Lastly, according to survey results, the initiatives that could be most effective in lowering electricity use require the individual metering of rooms to track consumption. Several of the suggested techniques to lower energy consumption include: 1) encourage the use of or provide energy efficient refrigerators, 2) highlight preexisting university initiatives, 3) start educational campaigns for students on energy conservation, 4) facilitate energy conservation through subsidies, and 5) improve the design of the rooms to ensure energy conservation. By implementing some or all of these techniques, it is likely there will be a reduction of electricity in student housing.

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Climate change is the challenge of the 21st century. On September 15, 2009, University of Pennsylvania President Amy Gutmann unveiled the Climate Action Plan in front of dozens of students, faculty, staff, and local media, signifying the University's role in the fight against climate change. The Plan outlines numerous recommendations to lower Penn's carbon footprint. The largest contributor to Penn's emissions is running and maintaining the campus' buildings with electricity, heating, and cooling making up nearly 87% of the University's 2008 carbon emissions (PENN CAP 2009, 52). Penn has the goal of reducing energy usage by 5 percent from the 2007 baseline in fiscal year 2010, and a 17 percent decrease from the 2007 baseline by 2014 (PENN CAP 2009, 13). Since College Houses consume a large amount of energy and represent a large portion of Penn's total emissions, it is necessary to examine how residents are currently consuming electricity and potential techniques that will help Penn reach its energy goals.

The purpose of this thesis is to look at electricity consumption in student housing and specific techniques to achieve energy reduction at this level of the university. The paper seeks to advise specifically the University of Pennsylvania's Facilities and Real Estate Services and the Sustainability Team at Penn on potential techniques to reduce energy in student housing on campus. Additionally, it is likely that the findings in this paper could be adapted to other higher education institutions and therefore help other universities and colleges achieve energy reduction in their student housing.

The purpose of this study is observe how residents use electricity in Penn's 11 College Houses, what has shaped residents' electricity consumption, and potential techniques for energy reduction. Since College Houses and other residences were responsible for over 15% of the emissions, an analysis of ways to reduce energy consumption in this type of environment can inform leaders of the ways to reduce the impact that residents have on their buildings and their emissions (PENN CAP 2009, 39). Additionally, the findings could be used to influence the types of appliances found in College Houses, to

implement types of potentially successful policy changes and education campaigns, and/or to make significant changes in the design of dorm rooms.

Four main sections comprise this thesis. The paper begins with an introduction to Penn and its sustainability background. Additionally, this section provides a review of literature on climate change, energy use in buildings, the role of universities have in combating the problem of climate change, and specific techniques higher education institutions have implemented to reduce energy consumption. The next section describes the research design of the thesis looking at both the methodology and study design used. Results from the thesis, using surveys and energy audits, including the survey demographics, assumptions, electricity used, and strategies for electricity conservation, comprise the third section of the paper. In the fourth section, the thesis discusses potential techniques to lower energy consumption at Penn and the limitations of the thesis.

## Introduction

### Introduction to Sustainability

As the human race entered a new millennium, the challenge of climate change threatens its existence. Fundamental macro-level changes in last the 300 years have altered the way humans lived on the planet since the dawn of civilization. These macro-level changes may be referred to as TEDIC factors: technological developments, economic growth, demographic factors, institutional factors, and cultural developments (Abrahamse et al. 2005, 2). All of the TEDIC factors have produced an unsustainable way of living, threatening our existence through climate change. To overcome this challenge, professionals, experts, and government leaders are starting to encourage others to live "sustainably" to decrease the negative effects that humans are having on Earth. The most cited definition of sustainability comes from the 1987 World Commission on Environment and Development report, *Our Common Future*. Its definition of sustainable development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Our Future 1987). While

somewhat vague, this definition offers an overview of what is generally accepted to be "sustainable" and the idea of continuation and longevity through not just environmental protection but through economic and social well-being as well. Over the past decade or so, sustainability and sustainable development has been a growing trend in influencing how people behave and make decisions.

**Penn's Story**

In recent years, the University has begun its fight against climate change developing guidelines for how Penn should develop as an educational institution. The first large stride Penn took was signing the American College and University Presidents' Climate Commitment, or ACUPCC, in 2007. Currently, the ACUPCC has more than 650 signatories and represents college and university presidents and chancellors' commitment to pursue climate neutrality and integrate sustainability into the curriculum. In total, the ACUPCC signatories represent more than 30% of college students in America (Bardaglio et al. 2009, 35). By signing the ACUPCC, Penn is responsible for setting a plan to reduce its emissions within two years. To remain compliant with the Commitment, Penn initiated three sustainability ventures. First, the Environmental Sustainability Advisory Committee (ESAC), made up of various, specialized subcommittees (academics, transportation, etc.), was created to develop recommendations for the Office of the President. The goal of ESAC was to "gain input from the entire University on strategies to improve campus sustainability and reduce carbon emissions, research best practices at peer institutions, and use this information to develop Penn's *Climate Action Plan*, or CAP, by Fall 2009 for submission to the ACUPCC" (PENN CAP 2009, 27). Additionally, President Amy Guttmann named Dan Garofalo the University's first Environmental Sustainability Coordinator. In 2008, Garofalo established the Sustainability Team, in the division of Facilities and Real Estate Services in the Office of University Architect, to prepare the Climate Action Plan using the ESAC goals and take on university sustainability initiatives. Lastly, President Gutmann instituted the Green Campus Partnership (GCP) as the "umbrella group to address environmental sustainability and stewardship on campus" (PENN CAP 2009, 29). GCP

encompasses all of Penn's current sustainability initiatives by "providing a web presence and a comprehensive communications strategy to provide outreach and updates to the University" community (PENN CAP 2009, 29). These three ventures culminated with the release of Penn's *Climate Action Plan* in Fall 2009, however, GCP and the Sustainability Team still operate to carry on the initiatives that the CAP laid out.

In the CAP, Penn has outlined steps to eventually achieve climate neutrality and enhance the role of sustainability at the University. ESAC subcommittees formed goals that would help Penn reduce its emissions and produce an increasingly sustainable campus. In addition to the goals, it suggested strategies to help Penn reach those goals. Both the goals and strategies are summarized in Table 1 on page 8.

A comparison of Penn's sustainable higher education strategies in the CAP in comparison with other schools' strategies reveals that Penn is generally not taking as drastic measures as other institutions. While Penn has the academic goal of making "climate change and environmental sustainability a part of the curriculum and educational experience for all Penn students," other schools have expanded beyond this incorporating sustainability into most, if not all, of the academic courses (PENN CAP 2009, 14). For example, at Northern Arizona University, faculty members participate in the Ponderosa Project, which combines far ranging courses such as music, engineering and business, with issues of environmental sustainability. Currently, the Project operates as "a forum through which faculty across campus can explore the necessity for interdisciplinary approaches to research and teaching about sustainability while also lobbying the administration for a stronger university-wide commitment to sustainability" (Chase et al. 2004, 91). Instead of simply adding courses on climate change and environmental sustainability, Penn could infuse those issues into pre-existing courses like in the Northern Arizona University example, thereby emphasizing the role that climate change and environmental sustainability currently play in the issues that students currently study. Other institutions

are going beyond their academic role and completely reevaluating its environmental impact. For instance the Higher Education Environmental Performance Improvement Initiative (HEEPI) in the United Kingdom, higher education systems have the dual purpose of developing better data about the

Table 1. Summary of ESAC Subcommittee Recommendations

| Subcommittee | Goal | Strategy 1 | Strategy 2 | Strategy 3 |
|---|---|---|---|---|
| Utilities and Operations | Reduce energy usage by 5% from the 2007 baseline in fiscal year 2010, and a 17% decrease from the 2007 baseline by 2014 | Eliminate the growth in energy use in existing buildings through education and management | Improve the efficiency of existing buildings' utility systems and adopt conservation measures | Continue purchase of renewable energy credits (RECs) |
| Physical Environment | Create and maintain a sustainable campus | Adopt LEED Silver Certification as a minimum standard for new construction and major renovations | Provide training to Penn staff on sustainable design and construction practices | Implement increasingly sustainable protocols for site planning and landscape maintenance |
| Transportation | Emphasize and plan a quality pedestrian campus environment, encourage use of public transportation for commuting, and provide efficient local transportation services for the University community. | Investigate public transportation subsidy | Improve bicycle and pedestrian environments | Improve the fuel efficiency of Penn's vehicle fleet |
| Waste Minimization and Recycling | Double Penn's diversion rate of paper, cardboard, commingled recyclables to 40 percent by 2014, and reduce Penn's overall waste stream | Institute a comprehensive waste minimization and recycling policy | Provide widespread education about why and how Penn recycles | Ensure adequate provision of recycling and waste bins within campus buildings and public spaces |
| Academics | Make climate change and environmental sustainability a part of the curriculum and educational experience | Launch a new University undergraduate minor in Sustainability and Environmental Management, available in Fall 2009 | Provide sustainability-related programs for faculty, staff and students, such as workshops and proseminar classes | Expand student participation in sustainability research |
| Communications | Develop clear, concise, and accurate information about Penn's sustainability commitments, while encouraging Penn's community to participate | Establish and reinforce messages that individual behavior is critical in meeting the Climate Action Plan goals | Ensure that all communications are accurate, easily accessible, and provide valuable up-to-date information | Create events that galvanize the campus community and bring attention to the University's sustainability campaign. |

environmental impacts of higher education institutions and establishing processes that integrate environmentally friendly practices with existing programs. This initiative looks mainly at the integration of planning, decision-making and evaluation and its role in shaping the entire UK educational system around sustainability (Hopkinson et al. 2004, 78- 91). In order to help combat change at the largest level Penn could look at the set of principles from a series of workshops from various stakeholders about sustainable education at the University of British Columbia, Vancouver, Canada. The principles are "infuse sustainability in all decisions, promote and practice collaboration, promote and practice transdisciplinarity, focus on personal and social sustainability, integration of planning, decision-making and evaluation, integration of research, service and teaching, and create space for pedagogical transformation" (Moore 2006, 331).

**Penn's Energy Strategies and Current Initiatives**

Since the Sustainability Team completed the CAP, Penn has started to implement some of the strategies that the ESAC subcommittees recommended, focusing on energy consumption. Seeing that Penn's energy consumption is responsible for the majority of carbon emissions (projected to be 86% from its 2009 Carbon Inventory) and given the strict goals the subcommittee set, the University has focused much of attention on lowering energy consumption in campus buildings through six targeted emissions reduction measures (PENN CAP 2009, 53). They include a reduction in electric intensity, adoption of higher performance standards for new buildings, renovation of existing buildings to higher energy standards, re-commission existing building systems, improvement of the efficiency of existing utilities and infrastructure, and reduce emissions from air travel, solid waste, university vehicles and other smaller sources (PENN CAP 2009, 44-5). In 2008, electricity alone accounted for two-thirds of all emissions (PENN CAP 2009, 52). By reducing electricity consumption, Penn can greatly reduce the amount of emissions and achieve its energy reduction goals.

The way Penn currently receives its electricity presents a challenge for University leaders to change how much emissions Penn counts in its carbon inventory. Penn purchases its electricity from PECO (a unit of the Exelon Corporation). PECO's electricity supply comes from multiple sources, the majority of which are coal or nuclear plants. While Penn purchases renewable energy credits to offset 30% of its total electricity consumption, all of the wind power generated from the credits does not necessarily add to Penn's energy mix that it receives from PECO, but adds renewable energy to the mix in general (PENN Phase I 2006, 23). PECO chooses fuel types based on prices in the energy market. Different fuel types release different types and amounts of emissions, including $CO_2$, $SO_2$, and $N_2O$ gases, into the air. As the University uses a great amount of energy, it is accountable for the emissions generated by PECO and is therefore included in its carbon footprint. Additionally, all of the energy produced for Penn does not necessarily make it to campus, as in the United States, 7% of electricity is lost in transmission and about 60% of the energy in fuel used to generate power is lost as heat (Bauers 2009).

The University of Pennsylvania's diversity of campus buildings, in both type and age, represent another challenge for University leaders to tackle a reduction in energy consumption. In its West Philadelphia campus, Penn, not including the medical campus, consists of 279 acres with 182 buildings (PENN FRES 2009). Totaling 12.1 million gross square feet, 24% is office space, 21% is College Houses and other residences, 19% is labs, and the remaining 36% is divided between instructional and study spaces, athletics, assembly, food services, and support. Additionally, the age of campus buildings range from the newly constructed to those with significant historical status. Out of the 151 buildings, 19% of them were constructed prior to the 20$^{th}$ century, 55% were completed after the end of World War II, including a large amount of construction that occurred during the 1960's and 1970's. There are also several buildings constructed after 2000 (PENN Phase I 2006, 10-1). Most importantly, a majority of these buildings are not individually metered to track electricity consumption.

Such a large variety of buildings of different ages and the way Penn currently receives its electricity force University leaders to reduce energy consumption in a variety of ways. Outside of large capital projects to renovate buildings and thereby increase energy efficiency, Penn has looked at other means to decrease energy consumption. Behavior change through education is one strategy through which that the University hopes to eliminate the growth in electrical intensity in existing buildings. Initiatives include adding messages of energy and resource savings in New Student Orientation presentations, developing the Eco-Reps program (peer-to-peer education training in College Houses on sustainable issues), piloting the Harnwell Energy Monitoring Project (a system to measure utility consumption in select rooms and house wide consumption), and working with the PennGreen Freshmen Pre-Orientation program to promote energy savings through behavior modification. Additionally, Penn works with the Penn Environmental Group, or PEG, on numerous sustainability projects throughout the year. One initiative they help sponsor to reduce energy consumption is the light bulb or CFL exchange, a program designed to allow on-campus residents to trade in incandescent bulbs for more energy efficient compact fluorescent bulbs.

While Penn is taking on numerous initiatives to produce a more sustainable university, it is important to review the literature surrounding climate change, what factors produce it, and how other universities are dealing with this problem.

## Literature Review

### Climate Change and the Role of Energy

The role of economic globalization, the use of modern technology and the impact of tremendous population growth over the last three centuries has led humanity to a time of an uncertain future. People's daily actions and the demand placed on resources, or humanity's ecological footprint, exceeds the earth's regenerative capacity by about 30% and continues to grow (WWF et al. 2008, 4). The

largest impact that humans have on their ecological footprint is through climate change because of the various consequences of this fundamental transformation in the environment (Bardagio 2009, xvi).

The main cause of climate change is people releasing an ever-increasing amount of greenhouse gases (GHGs) since the beginning of the industrial revolution (IPCC 2007, 37). From the period of 1970 to 2004 alone, GHG emissions have increased 70 percent (IPCC 2007, 36). GHG emissions are a by-product from numerous daily activities such as powering homes, transporting goods, and manufacturing products. One of largest sectors responsible for the growing amount of GHGs is electricity generation for industries, businesses, and residences. According to the Intergovernmental Panel on Climate Change, electricity consumption accounts for over half of the world's global anthropogenic GHG emissions (IPCC 2007, 36). Additionally, it is expected that energy demand will increase in the following decades because of population growth and increased consumption. A recent study by the World Energy Council expects energy consumption to increase from 22 billion kWh per year today to 53 billion kWh per year by 2020 (Omer 2008, 2267).

**Energy Use in Buildings**

Energy for buildings is used in a variety of ways and across different economic sectors. For example, in the residential sector of the United States, the largest users of energy are space heating (41%), lighting and appliances (26%), and water heating (20%) (EIA 2005). Electricity was the second most widely consumed energy source for the residential sector after natural gas, making up 41% of the residential energy source (EIA 2005). Electricity is used to power lights and appliances, such as refrigerators, televisions, and computers, and is sometimes used to heat homes.

The worldwide increase of appliances is a major factor for the increase in energy use. In China, for every 100 urban households, there are 133 color televisions, 96 washing machines, and 70 room air conditioners (Brown 2008, 219). Other than the increase of appliances, the standby power – power consumed when the appliance is not being used but still plugged in – is an increasing source of energy

use. In 2007, the estimated share of standby power used by appliances was 10 percent of total electricity consumption (Brown 2008, 220).

Forecasted energy demand and costs coupled with energy's negative production effects via GHGs and the strain on electricity infrastructure have prompted governments, companies and individuals to reevaluate actions concerning energy use in buildings. The two principal ways to lower energy (and electricity) are through energy efficiency practices, "the use of technology that requires less energy to perform the same function," and energy conservation, "any behavior that results in the use of less energy" (EIA). A major challenge with energy efficiency is the high initial capital investment needed before investors see a return on their asset. On the other hand, energy conservation strategies are becoming more popular because of user controlled heating/cooling systems and appliances and the little to zero monetary investment required (Junnila 2007, 330).

**Role of Universities during Climate Change**

The role of higher education in addressing climate change extends well beyond reducing energy consumption in campus buildings because of its primary role of educating a population in a localized setting and also controlling an environment efficiently as compared to other locations. As higher education systems did for social problems of the past (the women's rights movement, civil rights movement, etc.), it can play a "pivotal role" in creating a change towards dealing with the causes and consequences of climate change (Corcoran et al. 2004, 3). Compared to a city, a university can more directly control its population and therefore have more of an absolute impact. For example, a university composting initiative would be easier to undertake than a in a city because of the compact setting, less political red-tape to overcome, a single stream of waste management, and a smaller population with similar attitudes. Additionally, the initiative would educate the population enforcing the sustainable behavior for the rest of their lives. The university case for leading the sustainability movement is that it

can shape the future of a select population that can influence others while also having an immediate impact in a confined, but large-scale setting through its purchases and initiatives.

While the case for sustainable development in higher education may be clear, the motivation for it differs. In some cases, leaders believe that higher education should encompass sustainable development in all aspects of the education system. For example, Lawrence Bacow, president of Tufts University, and William Moomaw, a professor at Tufts, argue that educational institutions are motivated by three factors to lessen the effects of climate change and create a more sustainable university. These factors are:

1. "Economics. It is economically advantageous to reduce pollution to lower future liabilities under the law and to achieve economic efficiency of an institution's operations to improve the bottom line financially.
2. Ethics. Reducing environmental impact is simply the right thing to do ethically, because it reduces harm to others now and allows the planet to continue producing environmental goods and services to future generations.
3. Mission. Reducing environmental impact is central to the mission of an organization" (Bacow et al. 2007, 38).

On the other hand, others view sustainable development as merely a tool to brand a university. While schools may realize some of the benefits of the sustainability movement, it is not the overwhelming measure to lead a university to become sustainable. Some universities see success in strengthening yield, retention, and fundraising and if branding the university as "sustainable" will increase the bottom-line, then that will be their main motivation (Bardaglio et al. 2009, 50-1).

The most direct impact that Universities can have on climate change is through changes in their energy use. Since Universities consume a large proportion of energy through their classrooms, libraries, residence halls and offices, they can make many steps to lower their energy. First, efficiency is

important, as it is more affordable (long-term) than purchasing additional electricity. Additionally, it is better for the environment because building operations contribute the largest proportion of GHG emissions and an increase in energy use would result in higher emissions (Bardaglio et al. 2009, 127). Second, energy conservation by students, faculty and staff is another important way energy reduction can be achieved. Since energy efficiency can only go so far to reduce energy use because user control ultimately decides how much energy is being consumed, positive behavior change is necessary to witness the greatest effectiveness in energy reduction. For example, a computer can be the most energy efficient model, but if it is plugged in and left on all the time then it uses more energy than a less-energy efficient computer that is turned on only when needed (Bardaglio et al. 2009, 127-131).

**Techniques of Energy Reduction**

Energy conservation primarily relies on behavior change of an individual; however, individuals must value a behavior before change can occur. Before behavior change can be achieved, generally attitude change must happen first. Although people do not always act consistently with their beliefs, typically attitudes account for the reason why humans behave the way they do. Thus, to achieve behavior change regarding environmental sustainability, environmental sustainability must be valued. The level at which it is valued will determine how far individuals will go to achieve far-reaching and possibly inconvenient changes (Arbuthnott 2008, 153). For example, a person that is highly committed to energy conservation may be more willing to change their behavior than a person who values it less.

Placing value through motivators such as monetary savings, education, marketing, incentives, inconvenience, and disincentives will result in behavior change. Generally, household residents who pay for electricity respond best to monetary benefits through monthly energy savings (Abrahamse et al. 2005). In a study on motivating residents on military bases to conserve energy without financial incentives, Andrea H. McMackin et al. conclude that it is best to combine a variety of motivators to institutionalize energy conservation. Some of the motivators studied include environmental and

parental responsibility, education campaigns, lifestyle benefits, incentives, and disincentives (McMakin et al. 2002). In most higher education institutions, like military bases, monetary benefits through monthly energy savings are not possible because students' electricity usage is not measured and therefore the institution does not know how much energy students have consumed or saved. When institutions are able to meter energy consumption and potential savings, students respond by reducing their energy. For example, when Oberlin College installed components for real-time monitoring systems in all of College's dormitories to allow for visual feedback of building residents' electricity and water consumption in conjunction with a competition, the result was a $5,000 in electricity savings and $200 in water-use savings over a two-week period (Petersen et al. 2007).

Another way to motivate students to decrease their energy consumption is to illustrate the potential savings, monetary and environmental, through both energy efficiency and energy conservation. By estimating the appliances and its time of use, one is able to calculate the energy consumed and potential modifications to products and behavior to reduce energy. This was the case with Tulane University's ENERGY STAR dorm room. The dorm room educated students, their families and faculty of the potential monetary and environmental savings of a dorm room that had the most efficient appliances as well as exercise best practices of conserving energy. Overall, the dorm room showed the simple changes could be done to lower the energy in a distinct setting (Kahler 2003).

Since installing the meters is a large undertaking with high costs and potentially unknown results and estimating energy consumption is not accurate or fully realized, other means must be implemented to place value on energy conservation. Another motivator is an educational campaign based on community-based social marketing, or CBSM (Bardaglio et al. 2009, 101). CBSM applies a commercial marketing model (involving market research, planning, pricing, etc.) to social ideas, instead of products (Marcell et al. 2004). This type of marketing campaign focuses on "initiatives delivered at the community level which focus on removing barriers to an activity while simultaneously enhancing the activities'

benefits" (Bardaglio et al. 2009, 101). In 2004, community-based social marketing techniques were applied to an energy conservation initiative put forth by Tufts University. Kristin Marcell, Julian Agyeman and Ann Rappaport assessed the cost-effectiveness of this marketing strategy in addressing energy reduction. By comparing a dormitory that received only an educational program on energy conservation to one that received an educational program that incorporated social marketing methods, the researchers concluded that the social marketing campaign had a greater impact on student environmental knowledge, attitudes, and behaviors than the educational program alone. However, the study found that for the community-based social marketing to be most cost-effective, it needs to focus on specific topics that could save the University money. For example, a $15,000 marketing campaign to educate students about turning off their computer at night might save the university many times the amount spent on the campaign (Marcell et al. 2004).

Various other motivators for energy conservation have been used with a wide range of success. In "A review of intervention studies aimed at household energy conservation," Wokje Abrahamse et al. evaluate the effectiveness of motivators, such as visual feedbacks, informational campaigns, informational workshops, energy audit, rewards, financial incentives, and prompts, through a comparison of thirty-eight intervention studies. Some of the most successful strategies include providing feedback with goals setting, any type of a reward for positive behavior, establishing a sense of commitment towards energy reduction, and conducting home energy audits with tailored advice to reduce energy consumption (Abrahamse et al. 2005). Lastly, they noted that interventions work most effectively when they address and change the barriers that limit behavioral change. For instance, an educational campaign based on energy conservation would not be very helpful towards students who are already knowledgeable on the subject and perhaps incentives or tailored feedback would work better to reduce energy consumption (Abrahamse et al. 2005).

## Research Design

### Methodology

This thesis uses two methods to conduct research surrounding the topic of energy consumption in student housing. First, a random survey of University of Pennsylvania on-campus residents was conducted using www.surveymonkey.com. The survey had three components. In the first component, the survey asked basic questions about the student's background and views towards environmental issues. Questions focused on how and when residents learned about living more sustainably and their potential involvement in making Penn more sustainable in the second part of the survey. The aim of these sections was to allow for a comparison between background factors and behavior by learning about residents' concerns about the environment and their attitudes towards potential change. Additionally, the first section served as a way to see if the people who took the survey were biased towards acting sustainably as numerous questions were asked regarding their participation in environmental groups and classes. In the last section, the survey asked questions concerning sustainability at Penn and their view of the projected success of energy conservation initiatives. The objective of last section was to ascertain the use and effectiveness of messages on sustainability at the university level, what the greatest barriers to energy conservation are, and to what degree students would support sustainable energy initiatives at Penn.

The second method was an energy audit conducted in volunteers' dorm rooms. The energy audit estimates the total electrical consumption per room by measuring each electrical device's wattage and then approximating the device's use throughout the day. This estimation can then be multiplied over a given period to see how much electricity students are consuming. The purpose of this audit was threefold: to see the total amount of electricity consumed and allow a comparison with different room set ups, what devices consume the most energy and if there are possible alternates to these devices, and the potential impact of behavior change initiatives towards energy reduction.

**Study Design**

To find participants for this survey and energy audit, numerous people were needed to produce a reasonable sample size. Outreach for the survey was complete through known Resident Advisors (RAs) and Graduate Advisors (GAs), all 11 College House staffs, current professors' students, and select major departments. This outreach was done via email asking them to participate in the survey (if they lived in one of the College Houses) and/or to forward the survey to those who did live in on-campus housing. To compensate students for participating in the survey, a $50 cash prize was awarded randomly to a selected survey respondent.

As for the energy audit, volunteers' rooms were measured based on an optional question in the survey that asked if they wished to participate. The purpose of the energy audits was not to provide overwhelming statistically significant data to produce an overview of electricity consumption for the entire university, but to look specifically at total proportions of energy consumption of appliances in rooms and if potential behavior changes would produce a significant savings.

## Results

**Survey demographics**

The data collected from the survey produced a significant sample size. Currently, there are 5531 non-staff residents in the College House system; see Table 2 for breakdown by College House (Penn College House Brochure 2009). During the 25 days that the survey lasted, 218 participants took the survey out of the 5531 potential survey takers. The sample population of the survey represents the total residents at a 95 percent confidence level with a confidence interval of 6.5.

Table 2. Number of Residents by College House

| | Number of Residents |
|---|---|
| W.E.B. Du Bois College House | 169 |
| Fisher  Hassenfeld College House | 461 |
| Gregory College House | 248 |
| Harnwell College House | 772 |

| | |
|---|---|
| Harrison College House | 797 |
| Hill College House | 508 |
| Kings Court English College House | 271 |
| Riepe College House | 464 |
| Rodin College House | 802 |
| Stouffer College House | 293 |
| Ware College House | 546 |
| Total | 5331 |

Overall, the sampled population is similar to the general population of the University of Pennsylvania. For example, the makeup of the undergraduate population of the survey nearly matches the percent that each undergraduate school population has from the fall of 2008 as shown in Table 3.

Table 3. Makeup of Undergraduate Student Population versus Survey Respondents

| | Undergraduate Population (Fall 2008) | Percent of Total | Percent in Survey |
|---|---|---|---|
| School of Arts and Sciences | 6404 | 61.8% | 67.4% |
| School of Engineering and Applied Science | 1609 | 15.5% | 14.0% |
| School of Nursing | 488 | 4.7% | 5.4% |
| The Wharton School of Business | 1866 | 18.0% | 16.7% |

Additionally, the sampled population resembles the typical College House resident population as most of the survey takers anticipated to graduate in 2012 or 2013 and were 19 years old or younger. This corresponds to the general trend of freshmen and sophomores living on campus, then as juniors and seniors to moving off campus.

Furthermore, there was not a large population of survey respondents showing bias towards sustainability issues as most were not involved in any sort of environmental group or department. See Table 4.

Table 4. Environmental Background of Survey Respondents

| Answer Options | No |
|---|---|
| Are you an Environmental Studies major? | 94.9% |
| Are you an Environmental Studies minor? | 99.1% |
| Have you taken a class in Environmental Studies? | 81.0% |

| | |
|---|---|
| Have you taken a class regarding environmental sustainability at Penn? | 94.9% |
| Are you a member of the Penn Environmental Group? | 89.8% |
| Are you a member of the Green Campus Partnership? | 95.8% |
| Do you belong to any sort of environmental group, either at home or on campus? | 81.5% |

Every College House on campus participated in the survey (Table 5). However, nearly a quarter of the survey takers were from Stouffer College House. This disproportionally high number can be attributed to the fact that one particular individual sent the outreach email to everyone in the College House, which was unique to the survey.

Table 5. College House Makeup of Survey Respondents

| | Number of Survey Participants | Percentage of Survey |
|---|---|---|
| W.E.B. Du Bois College House | 20 | 9% |
| Fisher Hassenfeld College House | 15 | 7% |
| Gregory College House | 11 | 5% |
| Harnwell College House | 7 | 3% |
| Harrison College House | 20 | 9% |
| Hill College House | 7 | 3% |
| Kings Court English College House | 31 | 4% |
| Riepe College House | 6 | 3% |
| Rodin College House | 28 | 13% |
| Stouffer College House | 56 | 26% |
| Ware College House | 17 | 8% |
| Total | 218 | 100% |

**Assumptions**

This thesis makes several assumptions in interpreting the energy audit and survey data. First, energy involved in dorm room heating and cooling was excluded from calculations. This was due to the lack of control that students have over heating and cooling and since electricity consumption via appliances would signify the greatest amount of user controlled energy consumption. Second, the thesis made several assumptions regarding the estimation of electricity use from the energy audits. A 34 week academic year (16 weeks for Fall semester and 18 weeks for Spring semester), which excluded winter

recess, spring break, and summer recess, was employed in all calculations because little information was available concerning the number of residents on campus during school breaks and their electricity consumption habits at that time. In addition, the price of electricity was assumed to be a uniform $0.10/kWh because this is the average, current rate that Penn pays at for its electricity (PENN Phase I 2006, 6).

Furthermore, the energy audits results are by electricity consumed per resident as products shared by roommates are divided by the number of people using them. For example, the energy consumed by a light in a common room is divided in half as both roommates share the light, while a desk lamp's electricity in a bedroom is attributed to that particular resident. Assumptions are also made about total electricity use for miniature refrigerators and refrigerators because these devices would need to be measured over a period of time. These assumptions can be found in Section C of the Appendix. Lastly, some of the measured appliances would read "0 watts" while they used some electricity (the device would have registered "No load" if it consumed no power). During the calculations, 0 watts was changed to .4 watts to account for the minimal amount of electricity consumed.

Lastly, in this study, waste energy refers to energy being consumed that is otherwise not useful. An example of waste energy is a printer left "on" but not currently in use. In this study, waste energy does not include all forms of standby power – power that is being consumed when an appliance is not being used but still plugged in. One such example is an appliance that has a clock built in. While this appliance does use idle energy or standby power, the usefulness of the clock function does not make this form of energy wasteful.

**Electricity Usage**

To calculate electricity consumed per capita per room, the thesis uses several equations. First, electricity consumption per device needed to be figured out. This was done manually by measuring the

wattage of each device with a Kill-A-Watt meter that read the energy consumption of the device at that particular moment. Readings for each device were taken in both its "full on" state (when the device was completely turned on and in its operational position) and "idle" state (when the device was plugged in but not being used and "off"). Again, energy consumption for miniature refrigerators or regular refrigerators was assumed based on energy guides of similar models. Once both readings were taken, the person's room who was being audited would estimate how many hours per day on average they use that device in its "full on" state. The thesis also noted if devices were kept plugged in or unplugged if a particular device was known to consume standby energy. This would indicate if a device consumed idle energy. Once estimated time used and electricity consumed (in both states) were known, that device could then be plugged into Equation 1 to calculate electricity consumed and "idle" energy consumed. Total energy consumed per day per appliance is the addition of both "full on" consumption and "idle" consumption. Next, to determine total energy consumed over the academic year, total energy consumed per day is plugged into Equation 2. Once it was determined if idle energy was waste energy, total waste electricity consumed per academic year per appliance could also be plugged into Equation 2. To figure out the cost of electricity used for both total electricity and waste energy, total electricity consumed per academic year per appliance or waste energy per appliance per academic year was multiplied by the price of electricity paid by the University, $0.10 per Kilowatt-hour, or kWh.

***Equation 1: Calculation of electricity consumed per appliance***

$$Watts \times Hours\ per\ Day = Electricity\ Consumed\ per\ Appliance$$

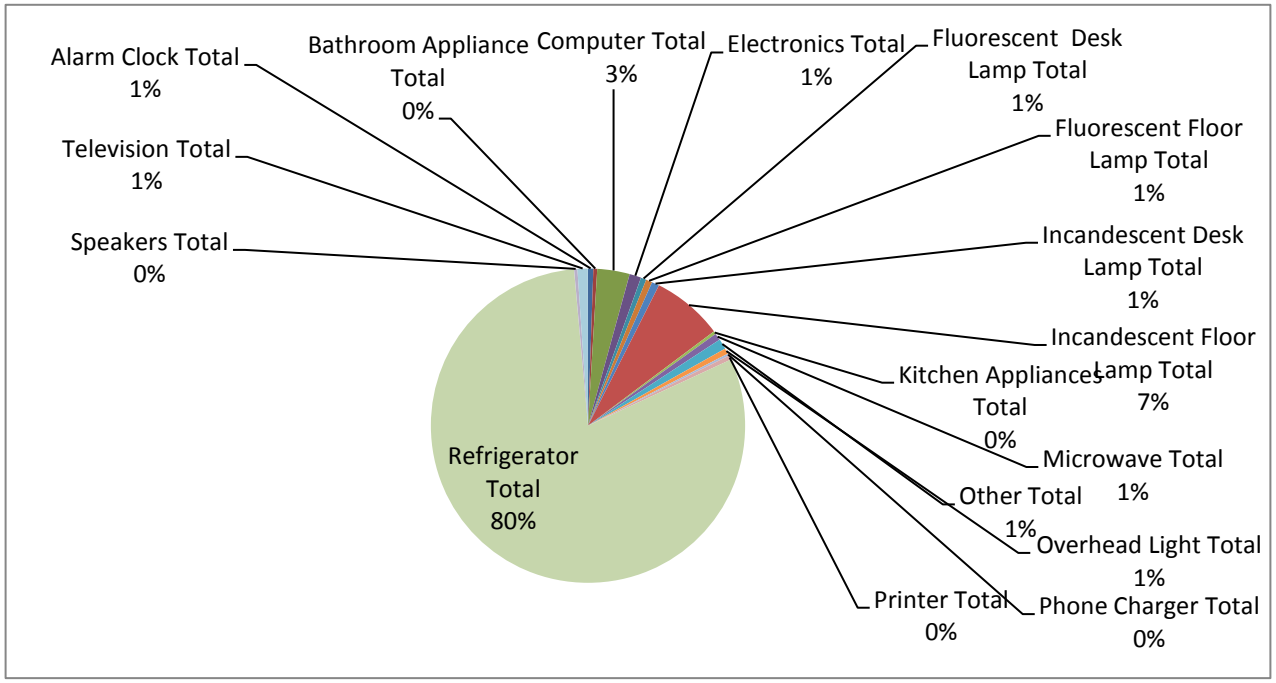
***Equation 2: Calculation of total electricity consumed per academic year per appliance***

$$\frac{Electricity\ Consumed\ per\ Appliance\ (in\ watts) \times 7\ days \times 34\ weeks}{1000\ Kilowatts} = Total\ Electiricty\ Consumed\ per\ Academic\ Year\ per\ Appliance\ (in\ Kilowatt\ Hours)$$

Calculations from the 14 energy audits are summarized on page 25 in Table 6 and individual audits are found in Section D of the Appendix.

Following the calculations from the energy audits, the results show that total energy consumption is dominated by the refrigerator, making up 80% of the total energy consumed. Following refrigerator electricity consumption is incandescent floor lamps (7%) and then computers (3%). The rest of objects measured make up either 1% or a non-significant number. In this chart, lighting makes up nearly 10% of the total energy consumed.

Figure 1. Total Energy Consumption per Academic Year

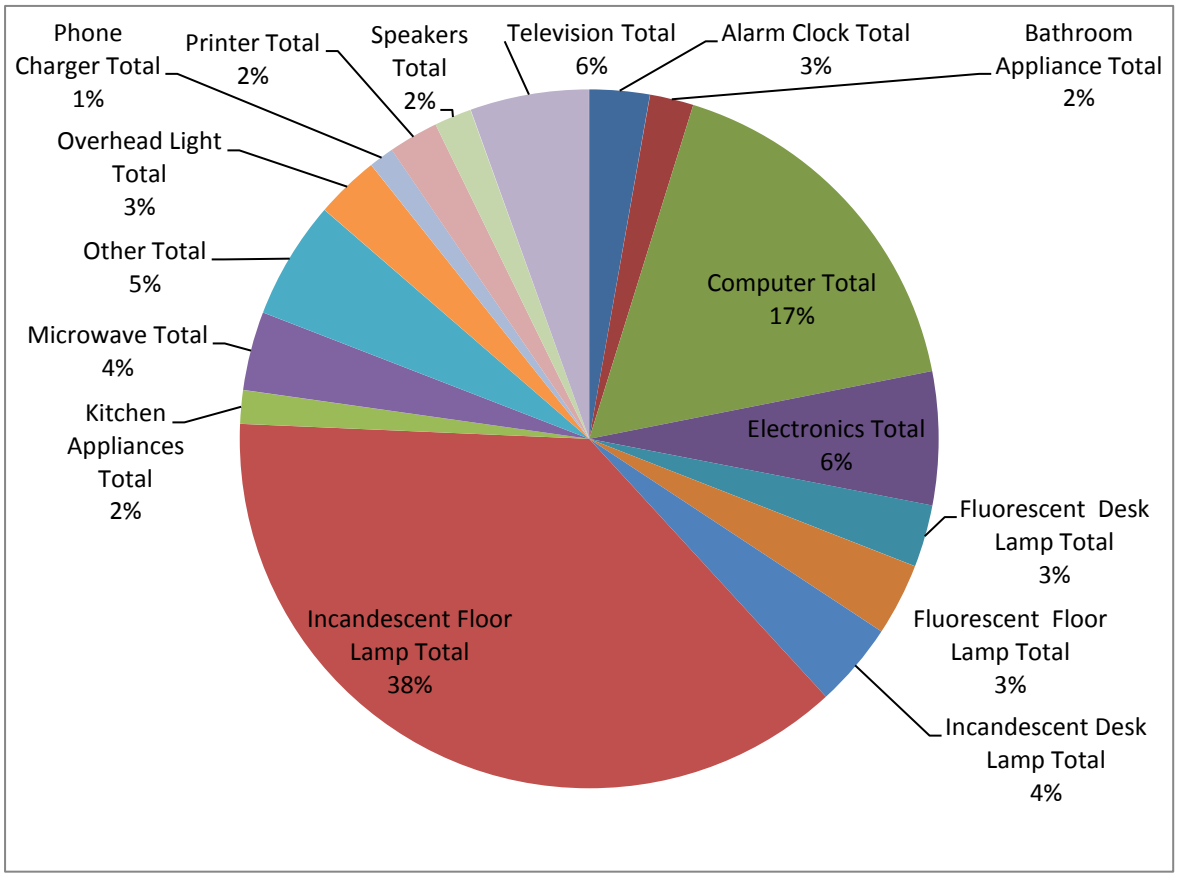



A closer look at the electricity consumed outside of the refrigerator reveals that lighting is the major source of electricity consumption making up over half the electricity consumed (51%). Following lighting, computers consume the next largest percentage (17%) and then television and electronics (6% each). Electronic devices include DVD players, video game consoles and external hard drives.

Table 6. Summary Table of Energy Audits

| | | Energy Consumption | | Totals per person | | | Totals | |
|---|---|---|---|---|---|---|---|---|
| | | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
| | Quantity | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Alarm Clock Total | 9 | 600.00 | 0.00 | 600.00 | 142.80 | $ 14.28 | 0.00 | $ - |
| Bathroom Appliance Total | 8 | 386.26 | 47.67 | 433.93 | 103.28 | $ 10.33 | 11.35 | $ 1.13 |
| Computer Total | 15 | 3537.00 | 136.20 | 3673.20 | 874.22 | $ 87.42 | 32.42 | $ 3.24 |
| Electronics Total | 11 | 1572.40 | 43.03 | 1323.83 | 315.07 | $ 31.51 | 7.97 | $ 0.80 |
| Fluorescent Desk Lamp Total | 7 | 621.90 | 0.00 | 620.70 | 147.73 | $ 14.77 | 0.00 | $ - |
| Fluorescent Floor Lamp Total | 12 | 879.17 | 0.00 | 718.59 | 171.02 | $ 17.10 | 0.00 | $ - |
| Incandescent Desk Lamp Total | 4 | 1032.00 | 0.00 | 837.00 | 199.21 | $ 19.92 | 0.00 | $ - |
| Incandescent Floor Lamp Total | 35 | 13080.00 | 0.00 | 8065.00 | 1919.47 | $ 191.94 | 0.00 | $ - |
| Kitchen Appliances Total | 11 | 446.80 | 23.97 | 333.34 | 79.33 | $ 7.93 | 2.85 | $ 0.29 |
| Microwave Total | 11 | 1377.72 | 0.00 | 783.86 | 186.56 | $ 18.66 | 0.00 | $ - |
| Other Total | 3 | 1201.00 | 0.00 | 1177.00 | 280.13 | $ 28.01 | 0.00 | $ - |
| Overhead Light Total | 12 | 1081.25 | 0.00 | 631.75 | 150.36 | $ 15.04 | 0.00 | $ - |
| Phone Charger Total | 14 | 151.00 | 99.50 | 250.50 | 59.62 | $ 5.96 | 23.68 | $ 2.37 |
| Printer Total | 8 | 58.60 | 436.42 | 495.02 | 117.81 | $ 11.78 | 103.87 | $ 10.39 |
| Refrigerator Total | 14 | 144672.00 | 0.00 | 88656.00 | 21100.13 | $ 2,110.01 | 0.00 | $ - |
| Speakers Total | 8 | 148.50 | 247.15 | 371.45 | 88.41 | $ 8.84 | 56.63 | $ 5.66 |
| Television Total | 8 | 1518.75 | 104.75 | 1184.25 | 281.85 | $ 28.19 | 17.43 | $ 1.74 |
| Grand Total | 190 | 172364.35 | 1138.69 | 110155.41 | 26216.99 | $ 2,621.70 | 256.20 | $ 25.62 |

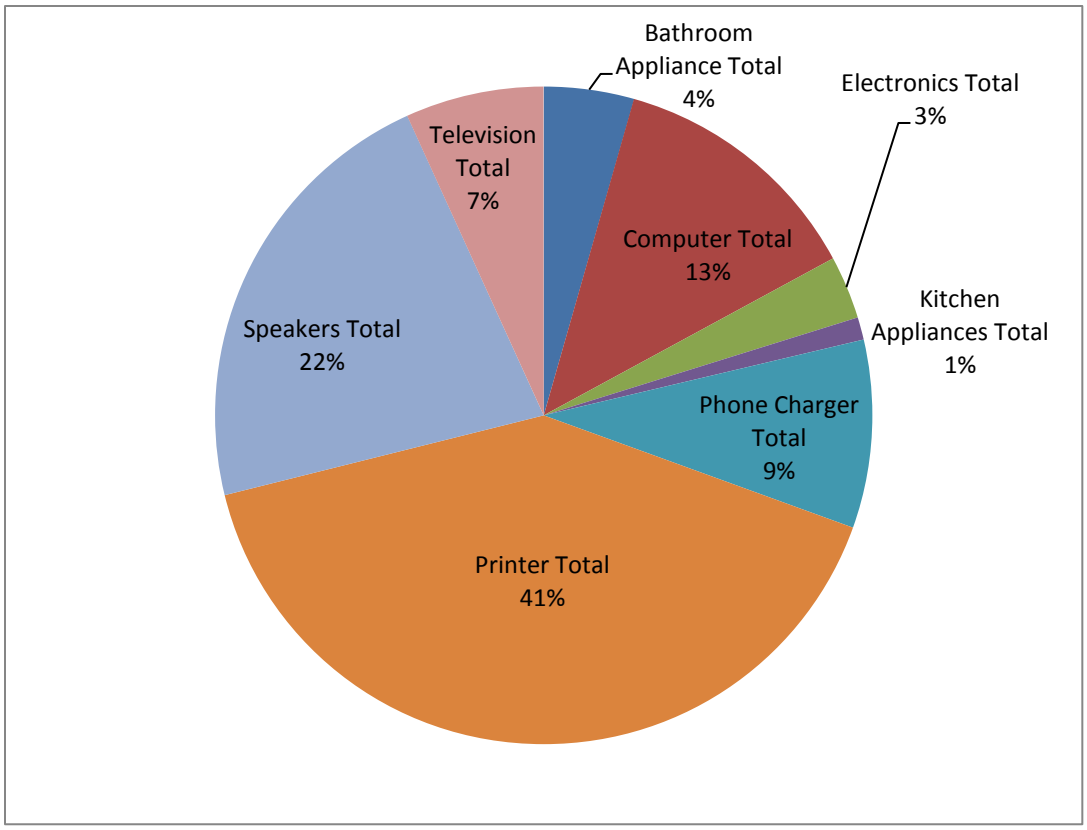
Figure 2. Total Energy Consumed per Academic Year (Minus Refrigerators)




By breaking the energy consumption into three categories of rooms studied, the thesis is able to see how the amenities and size of the room affect its electricity consumption. First, the range of energy audits was between 950 and 2885 kWh and the mean was 1873 kWh. On average, students living in singles consumed nearly 500 kWh more than those living in doubles did. This large difference in energy can be explained by the sharing of appliances and lighting, including refrigerators, thereby lowering the electricity consumption per person. Additionally, those rooms with kitchens, on average, consumed over 150 kWh more electricity over the academic year than those that did not have kitchens. This can be attributed to the larger size of the rooms (therefore more light is needed), larger refrigerators, and the added appliances students bring to complement their kitchen.

**Waste Energy**

Figure 3. Total Waste Energy Consumed per Academic Year




According to the energy audits, over 250 kWh (or 5% of the total electricity consumed excluding refrigerators) can be considered wasted energy. The largest contributor of waste energy is the printer (41%), followed by speakers (22%), computers (13%), phone chargers (9%), and televisions (7%). The large percentage of electricity wasted by the printer and speaker systems can be attributed to leaving the printers on all the time when not in use. The other devices' wasted energy results from standby power.

Electricity wasted by standby power may result from lack of awareness. While 80% of respondents of the survey turned off or put appliances to sleep when they were not in use, less than half were aware of the effects of standby power and less than a quarter are aware of it and do something about it. Additionally, only 32% of survey takers unplug appliances or turn off their surge

protector. This suggests that some students are merely unaware of their energy consumption. Coupled with the fact that only 21% of survey respondents attributed laziness as a barrier of consuming less electricity, this implies students would be likely to conserve energy if they just were aware of the effects of standby energy.

**Shaping Energy Consumption**

Based on the sample from the energy audits, some personal characteristics correlate with whether or not more energy residents consume more energy. The largest factor is age, as 18 and 19 year olds consumed 600 kWh less than 20 and 21 year olds. This can be explained by a larger number of 20 and 21 years olds having a kitchen in their room. Rooms with kitchens also have larger refrigerators, which affect total energy consumption. Another characteristic that determines levels of electricity consumption is whether or not students learned about living sustainably. While those learning about sustainable living techniques in elementary school consumed 30 kWh less than those who did not, those who learned about sustainable living techniques in college consumed nearly 500 kWh less than those who did not. However, a general interest in energy conservation may attribute to this difference. At Penn, the survey takers learned about living more sustainably through their peers and friends (57%) and also through on-campus environmental groups (47%). Since nearly 40% of survey respondents choose accurate knowledge as a barrier towards consuming less energy, this suggests an education campaign could play a large part in helping students consume less electricity.

Gender also played a role. The sample of females who took the energy audit used over 50 kWh more than their male counterparts. This could be due to the fact that females had more energy intensive products (hair dryers and hair straighteners) than males and some of them kept them plugged in, consuming standby power.

Another determining factor is the house size in which residents grew up. Those living in houses with four or more bedrooms consumed almost 300 kWh more electricity than those who grew up in

houses with fewer than three bedrooms. Since house size in the survey served as a proxy for family income level, this correlation could be interpreted as the wealthier the family income level is the more electricity one would consume. Additionally, this difference can be interpreted as residents who are used to consuming more electricity in bigger houses, will continue to consume more electricity in the future, than those who grew up in smaller houses.

Other factors examined but did not produce significant results were what region in the United States or country did the resident grow up and what was the resident's most important environmental issue. These characteristics did not produce any meaningful variation to make sound conclusions.

**Student Support**

Survey results indicate that students would support sustainability initiatives for reducing electricity consumption at Penn. Over 90% of survey takers reported being at least somewhat concerned about the environment and almost 30% viewed climate change and greenhouse gases as their most important environmental issue. Survey takers also indicated that outside their parents, the university is the largest group to support the initiative of living more sustainably. Additionally, over 70% were somewhat or very willing and 12% were extremely willing to change their habits to help the university lower its energy consumption. Moreover, individual actions by the students already indicate that students would support larger university-wide measures to lower energy consumption. For example, 93% of respondents turn off the lights when leaving rooms. Therefore, it is likely that energy conservation and efficiency initiatives by Penn would be successful in addressing both of these concerns, as some sustainable behavior is already present in the population.

While sustainability rankings provide a university-to-university comparison, many survey takers indicate that they did not have any strong feelings about the way Penn was ranked. Furthermore, 27% felt indifferent towards the ranking and 71% said that it somewhat or little affected their opinion of how Penn is doing against other schools in regard to sustainability. However, 95% believe that Penn should

be more sustainable and 25% were very willing to change their behavior to achieve a higher sustainability ranking. Respondents desire to make Penn more sustainable generally and through their own actions, in contrast to the survey takers' view on rankings indicates that being sustainable overall is more important than how rankings affects the University's image.

Survey takers also indicated that students would be willing to support some initiatives financially. A majority indicated that they would be willing to pay for a university provided energy efficient appliance in their room. However, less than 50% indicated that they would be willing to pay an optional fee to offset carbon emissions related to their time at their university or willing to contribute to a sustainable energy initiatives fund. For the university provided energy efficient appliance, nearly half said they would contribute $20 or less and almost 15% said they would contribute $50 or more. It is likely that students would be more willing to support this issue financially because the resident would interact with energy efficient appliance on a daily basis as opposed to a carbon offset or university sustainable fund both of which are less tangible.

Additional encouragement for university led initiatives is also supported by the fact that some survey takers voluntarily provided their own suggestions for how Penn can lower electricity consumption in student housing and willingness to participate in an energy audit. The fact that 28 people were willing to take extra time to offer their own ideas and 33 people were willing to have their room audited indicates residents' concern for lowering energy consumption on Penn's campus. The most popular suggestions were to make students pay for their electricity consumption, install motion sensor lights in corridors, and encourage others through word of mouth and prompts to reduce energy consumption.

**Strategies for Change**

How well messages are communicated regarding sustainable activities and initiatives is an indicator of how well students respond to such issues. In the case of Penn, students received numerous

messages about living more sustainably through a variety of sources. Survey respondents said that they received messages from Amy Gutmann (38%), on-campus environmental groups (38%), peers and friends (32%), and the Green Campus Partnership (25%). However, most respondents indicated that these messages were only a little impactful. Additionally, survey takers suggest that the Internet and peers and friends are the best way to learn about sustainable issues and becoming more sustainable. The survey demonstrates the need for Penn to reevaluate the methods used to communicate messages about sustainability and that students prefer these communications to come from the Internet and/or their peers and friends.

Survey respondents also answered questions about what initiatives, if implemented, would be the most effective to lower energy consumption at the Penn. According to the respondents, the initiatives that would be extremely effective would be to lower rent for students who use less electricity and an electricity bill for students living on campus, both of which would require the metering of buildings to measure the amount of electricity used. Other potentially effective initiatives that would not need buildings to be measured, as indicated by the survey, would be a sample energy efficient dorm room, a sustainability workshop during freshman orientation, subsidies to purchase ENERGY STAR appliances, an educational campaign about ways students can lower energy use, subsidies for students not to bring certain energy-intensive appliances to campus, the creation of events and promotions that demonstrate energy conservation, and a social marketing campaign that promotes energy conservation. The least desired initiatives would be to increase tuition to offset energy consumption, to develop an environmental education center on campus, or to hand out materials on sustainable living.

**Limitations**

This study has several limitations. First, only a small portion of the on-campus residents took the survey and an even smaller number participated in the energy audit. While the survey respondents produced a sizeable sample population with which to deduce enlightening conclusions, the small

amount of energy audits completed may have resulted in inaccurate findings, particularly when making a comparison between the survey results and energy audits. However, outside research, principally through the Tulane ENERGY STAR room, indicates that the proportions of electricity consumption by the appliances are approximately the same. Additionally, with a larger number of the energy audits, the thesis could have used a regression model to see what factors in a person's background are statistically significant in terms of how much energy they consume. Second, the assumptions people made in how often they use appliances in the energy audits are simply estimates and not exact; some people could have overestimated while others could have underestimated their usage. Refrigerator assumptions are also estimates as model numbers were unavailable. Furthermore, though the electricity use for shared items was split in half, it is likely that some individuals may use more of an appliance than others may. Lastly, the thesis sampled a majority of rooms – particularly rooms with kitchens – in older halls that Penn has not renovated recently. This could affect energy consumption found in rooms with kitchens.

## Discussion

The results of this study show that reductions in both the cost and impact of energy usage in Penn student housing are possible through technological improvements, simple policy changes, clearer communication, and behavioral modifications. Potentially effective measures include providing or encouraging the use of or energy efficient refrigerators, highlighting preexisting university initiatives, starting educational campaigns for students on energy conservation, facilitating energy conservation through subsidies, and improving the design of the rooms to ensure energy conservation.

### Refrigerators

In this study, refrigerators accounted for approximately 80% of the total consumed electricity use in student housing (see Figure 1). While eliminating this appliance completely from student housing would decrease energy consumption dramatically, this is unreasonable to the resident population as this appliance has become an integral part of modern lifestyles. However, there are other possible methods

to reduce energy use regarding refrigerators. Most of the refrigerators measured in the energy audit were provided by the university. Additionally, most of them seemed to be older models, indicating a lack of energy efficiency. If the university were to upgrade the refrigerators that it provides to its residents, Penn would greatly reduce electricity costs. Moreover, if Penn replaced the refrigerators with ENERGY STAR qualified ones, it would use 20% less energy than models that have not received an ENERGY STAR rating; this could save Penn $165 per refrigerator over the lifetime of the appliance (ENERGY STAR).

If students decide to bring their own refrigerators to school, policy changes could require that these be ENERGY STAR-rated models. To help lower the premium of purchasing an ENERGY STAR refrigerator Penn could collaborate with refrigerator manufacturers to lower the price of these refrigerators. On the other hand, if students do bring non-ENERGY STAR models, Penn could impose a fee to supplement the cost of electricity that Penn would pay over an ENERGY STAR model.

**Preexisting University Initiatives**

While Penn is already undertaking initiatives regarding energy conservation, the university could highlight the preexisting initiatives to reach a larger audience and therefore further decrease energy consumption. From the survey, there seems to be a general lack of awareness of most of Penn's sustainability initiatives. For example, most survey respondents did not know about Penn's Climate Action Plan, Penn's wind power purchases, the Green Campus Partnership, the 5% energy reduction goal in the Climate Action Plan, the CFL exchange, or the Big Belly (solar powered) trash cans. The only sustainable initiative/group that they were generally aware of was PEG.

One way to address the lack of awareness is to communicate better what Penn is already doing to address energy consumption. The CFL exchange, for example, would be more effective if more residents knew about it. The CFL exchange would make a large impact since 8% of total electricity consumed is by incandescent bulbs. Since the survey respondents indicated that their peers and their friends would be an effective way to be informed about sustainability issues, and given the relatively

high awareness of PEG, Penn might try highlight this initiative through PEG better. Overall, Penn could do a better job of communicating its initiatives in order to achieve greater effectiveness of its sustainability actions.

**Educational Campaigns**

One potential strategy to lower energy consumption involves an educational campaign to address residents' lack of understanding of how they impact climate change. Since it has been shown that students are willing to live more sustainably and that energy consumption is correlated with college education related to sustainability issues, it seems that one reason students consume so much is that they just do not know how much they are consuming. Additionally, this can be supported by the fact that 94% of survey respondents never paid for electricity before coming to college. As students that have never paid for electricity before, very few are likely to know the monetary consequences of energy consumption. Lastly, since nearly 40% of those chose accurate knowledge as a barrier to consuming less energy, an education campaign could play a large part in helping students consume less electricity.

This education campaign could address some technical issues regarding electricity consumption, its consequences, and simple behavior changes to help inform residents of their role in energy conservation strategies. While Penn is starting to educate its residents about living sustainably through energy saving behavior changes in both the New Student Orientation presentation and the Eco-Reps program, Penn needs to emphasize the impact of energy conservation in sustainable habits. While survey respondents thought that an education campaign would only be somewhat effective, this campaign could be valuable to achieving energy conservation throughout on-campus housing. As a majority of the survey respondents learned sustainable habits through their peers, the education campaign could focus on simple behavior changes and specific technical information. An educational campaign could include either individual energy audits by Penn or an ENERGY STAR dorm room to demonstrate current electricity consumption. Furthermore, an emphasis on educating first-year

students would have the greatest impact, as they will retain the knowledge from the education campaign for all of their remaining years at Penn.

Another strategy that could be effective is a CBSM campaign. The campaign could be more effective than the survey results indicate (most thought that this initiative would only be somewhat effective) because of the daily reminders that this technique would use could help lessen the effect of waste energy due to residents' lack of knowledge. If the marketing campaign focused on simple behavior changes that residents could make, as opposed to larger messages surrounding the issue of sustainability, it could be more effective. Since most survey respondents said that they were very or extremely willing to change their habits, simple, small changes in residents' behavior would be very likely. For example, by placing signs in residents' hallways about turning off lights when leaving their rooms could remind students about this simple behavior change they could make. Additionally, some sort of incentive for completing a behavior change could encourage additional change. At the University of Pittsburgh, a stress-ball in the form of a sheep was given out to those who downloaded a program to their computer that put their monitor to sleep when not in use (University of Pittsburgh). By adding incentives for positive behavior, students would be more likely to change their behavior, as they would value the action more.

**Subsidies and Funds**

Instead of trying to decrease energy consumption through behavior modification or by placing restrictions on personal belongings, the availability of subsidies could be an effective strategy to reduce energy consumption. A majority of survey respondents indicated that subsides that discourage bringing certain energy hogs to campus would be somewhat effective to lower energy consumption. The largest potential savings through an appliance would be through refrigerators because of the high amount of electricity they consume; however, it is likely other large energy consuming devices could also apply such as televisions. Additionally, if the subsidy was set lower than the cost of the electricity to run the

appliance, Penn could make money through electricity savings. For example, if a subsidy of $100 was given to a student who did not have a refrigerator in his/her room and it costs $200 to operate the refrigerator for the academic year, then Penn has the opportunity to turn a profit. Additionally, subsidies to use more energy efficient appliances could help decrease energy consumption. Survey respondents indicated that they would be willing to pay $10 or more to help pay for sustainable appliances in their room. While subsidies to cover energy efficient appliances would be lower than those not to bring them entirely, these subsidies would help save more electricity in general.

Other types of financial strategies for residents to consume less energy, besides subsidies not to bring certain appliances or to bring energy efficient appliances, seem less likely to be effective but could be implemented to help offset the cost of upgrading units or starting new sustainable initiatives. According to the survey results, residents are more willing to support an initiative financially if it directly affects them or will interact with the end product as opposed to supporting more general, university-wide funds or projects. In terms of paying an optional fee to offset a portion of the carbon footprint for living on campus, only 43% of the respondents said that they would pay for the fee, however, 50% said that they would be willing to contribute to a sustainable energy initiatives fund to sponsor the upgrade of various high-energy consuming mechanical devices that heat and cool buildings around campus. While both of these initiatives received only partial support, most responded by saying that would only pay $10 for the fee or fund. The amount residents would be willing to contribute may be too low for any particular actions to be made as the transaction costs for implementing such a financial strategy may be too great.

**Design of Dorm Rooms**

By enhancing the design of dorm rooms in certain ways, Penn and other universities can dramatically lower their electricity consumption. First, Penn could reduce the number of dorm rooms with kitchens. As this study found, rooms with kitchens typically use over 150 kWh more per academic

year than rooms that do not have kitchens. While removing kitchens entirely would require a lot of capital and would be unfair to the student population, kitchens should be considered a significant source of energy consumption in student housing. Besides reducing the total number of kitchens, Penn could also try to make sure that more people share kitchens as this will reduce the electricity consumption per person.

Another potential design enhancement involves improving the lighting conditions in students' rooms. First, Penn could lay out dorm rooms in such a way that maximizes the amount of natural sunlight coming into the rooms. This will decrease the need of electrical lighting as the energy audits revealed that lighting makes up 10% of the total electricity consumed. Second, better university-installed lighting would decrease the need for students to bring their lamps. While most rooms do have some overhead lighting installed by Penn, this only accounts for 6% of total electricity consumed from lighting. If the university decides to install energy efficient lighting fixtures, residents would have to rely less on bringing their own fixtures, which tend to consume more electricity than university fixtures.

The installation of power switches is another way that room design could help encourage energy reduction. If Penn installs power switches, similar in style to light switches but that control whether an electrical outlet is on or off, in dorm rooms, it would make wasted energy easier to control and facilitate behavior change. In most cases, to turn off an appliance completely, one must either unplug the appliance or turn off the surge protector. However, with the use of power switches, residents could simply flick off a switch instead of taking the time to unplug or turn off each surge protector. Some power switches are already located in dorm rooms; however, some people do not use them or are confused by how they should use them. In one case during the energy audit, a resident had her refrigerator plugged into an electrical outlet that was controlled by a power switch, making the switch useless as her refrigerator was kept on all the time. Conversely, in another case, a student properly used the power switch, which enabled him to turn off the non-waste energy appliances when he left the

room or went to sleep. Therefore, it is necessary to educate the students about the proper way to use power switches to lessen their electricity consumption, beyond simply installing them in the College Houses.

Instead of rewiring each room to have power switches, smart power strips are a cheaper alternative that perform the same function, with a couple of differences. Smart power strips allow residents to plug in numerous appliances, while having the ability to turn off some of the outlets. Depending on the model, the power strips come with external remote switches, nearly identical to light switches, allowing the person to turn a portion of the outlets on or off. Since 93% of survey respondents said that they turn off the lights when they leave a room, residents could do the same thing with their appliances by using smart power strip switches to reduce the amount of wasted energy.

The design improvement in college housing that would reduce electricity consumption the greatest is the metering of each room. Metering would allow Penn to bill students based on their electricity consumption. Given that residents respond best to monetary incentives for reducing energy consumption and survey respondents thought the most effective initiatives would both require the metering of individual rooms to measure the amount of electricity used, Penn should ultimately meter dorm rooms to make students responsible for the electricity they consume. Other effective initiatives, according to the survey takers, would be made possible even if the entire building was metered. For example, the metering of the entire building would allow the College Houses to have periodic competitions to consume less energy. By measuring the amount of electricity consumed, Penn could bill students based on their consumption like private renters and homeowners, making them financially responsible for the electricity they use and increasing the likelihood of overall energy reduction.

**Challenges of Potential Strategies**

The greatest barriers for Penn from the previously mentioned strategies are mainly monetary. In order save money, Penn needs to invest in strategies that are fiscally beneficial for the long term. For

example, the potentially most effective initiative to lower electricity consumption is to individually meter rooms in the College Houses to make the user financial responsible to pay for the power they consume. The upfront costs for such a project could have longer pay back periods than typical projects that the university takes on. In the case of real time monitoring at Oberlin, the two building metering systems cost $5,000 each (Petersen et al. 2007, 28). Installing systems that would measure the individual's room, not the entire building as in the Oberlin case, would likely cost many multiples of that, making the feasibility of metering individual rooms unlikely. Other potentially successful initiatives would also cost thousands of dollars. For example, subsidies for not bringing appliances could cost the University over $100 per refrigerator that is not brought; not including the transaction costs associated with administering each case and the fact that students may never have brought refrigerators in the first place.

Since shifting the responsibility of paying for electricity used in student housing from the university to the residents entirely would be extremely difficult, Penn should look at strategies that lower its energy consumption by placing some of the responsibility on the residents. The survey has shown that students are willing to support initiatives by both changing their behavior and contributing money for sustainable initiatives. However, Penn has done little to date to encourage energy conservation behavior in student housing. Initiatives that encourage students to consume less electricity (such as modifying behavior to use less standby power) or not at all (such as a subsidy to not bring a certain appliance) will only lower the university's electricity bill, not place added accountability on the residents. Until residents are at least somewhat monetarily responsible for their consumption, university led initiatives are necessary as they are the ones that will see the payback, not the student.

Challenges will also be encountered with initiatives that deal with behavior modification. Behavior modification may not take place even if there is some sort of campaign to produce change. To

ensure behavior modification, it is necessary to focus the modifications at specific actions and make sure that the value of creating change is greater than the cost of the initiative.

**Conclusion**

This study has shown that electricity consumption in student housing is high, but can be reduced in many ways. Through the completion of the energy audits, it was found that 80% of electricity consumed in student housing is used by refrigerators, 10% for lighting, and another 10% for electronics including televisions, computers, and speakers. Out of the total electricity consumed (excluding refrigerators), 5% can be attributed to waste energy. The largest contributors to waste energy are printers (41%), followed by speakers (22%), computers (13%), phone chargers (9%), and televisions (7%). To help reduce energy consumption, numerous techniques can be employed. Effective measures include encourage the use of or provide energy efficient refrigerators, highlight preexisting university initiatives, start educational campaigns to educate students on energy consumption, facilitate energy conservation through subsidies, and improve the design of the rooms to ensure energy conservation.

Outside of energy consumption, survey takers have demonstrated great support for sustainability initiatives. Over 70% were somewhat or very willing and 12% were extremely willing to change their habits to help the university lower its energy consumption. Additionally, individual actions, such as turning off lights when leaving a room, already indicate that students would support larger university-wide measures to lower energy consumption. A majority indicated that they would be willing to pay for a university provided energy efficient appliance in their room, however, less than 50% indicated that they would be willing to pay an optional fee to offset carbon emissions related to their time at their university or willing to contribute to a sustainable energy initiatives fund.

This study has shown that more can be done in regard to sustainable initiatives at Penn as there is a high level of electricity consumption and much support surrounding the issue of sustainability. However, the largest obstacles in lowering electricity consumption in student housing are educational

issues (eg. not knowing about standby power), awareness of current university programs (eg. Green Campus Partnership and CFL exchange), and monetary concerns about paying for new initiatives (eg. providing subsidies for not bringing certain appliances). If Penn could break down some of these barriers, it is likely that a reduction in energy consumption would be achieved.

Penn's motivation in terms of sustainability will indicate the next steps of how Penn should proceed. If Penn were motivated merely by the economic bottom line by branding themselves as a "sustainable" university, increasing the purchase of renewable energy credits would be the easiest monetary way to reduce its emissions. However, if Penn sees itself and higher education playing a more pivotal role in fighting climate change, then some of the highlighted techniques from this paper must be implemented to combat this problem. Additionally, more thorough audits regarding energy consumption should be done at Penn to ensure that these techniques are the best ways to proceed. Nevertheless, energy consumption in student housing has the potential to be reduced through both individual and university changes. By working together and by implementing some of these techniques, Penn will eventually meet its goals in energy reduction.

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**Appendix Contents**

**A. The Survey**

# Introduction

Welcome to the survey!

This survey is designed to help understand the motivation that residents in student housing have towards electricity conservation and what background factors influence their behavior.

This survey is ONLY for residents living in ON-CAMPUS, STUDENT HOUSING AT THE UNIVERSITY OF PENNSYLVANIA. If you do not live in one of the 11 college houses (W.E.B. Du Bois College House, Fisher Hassenfeld College House, Gregory College House (both Class of 1925 and Van Pelt Manor), Harnwell College House, Harrison College House, Hill College House, Kings Court English College House, Riepe College House, Rodin College House, Stouffer College House (both Stouffer Hall and Mayer Hall), and Ware College House), please do NOT take this survey. If you live in Sansom Place East or Sansom Place West, please do NOT take this survey either.

In this survey there are numerous questions that refer to sustainability and acting sustainable. In this survey, sustainability is defined as "a means of configuring civilization and human activity so that society, its members and its economies are able to meet their needs and express their greatest potential in the present, while preserving biodiversity and natural ecosystems, planning and acting for the ability to maintain these ideals in the very long term." Example "sustainable" actions include turning off lights while not in the room, recycling plastic bottles, and using a reusable bag at the grocery store.

Please click next page to proceed and enter your email to have the chance of winning $50 CASH.

# Background Info

| Q1. At Penn, I am a: |
|---|
| Undergraduate Student |
| Graduate Student |
| House Dean |
| Other Faculty Person |
| Other |

| Q2. What year do you expect to graduate? |
|---|

| |
|---|
| 2010 |
| 2011 |
| 2012 |
| 2013 |
| N/A |

| Q3. What School(s) are you in? |
|---|
| School of Arts and Sciences |
| The Wharton School of Business |
| School of Engineering and Applied Science |
| School of Nursing |
| Annenberg School of Communication |
| Graduate School of Arts and Sciences |
| Graduate School of Education |
| Law School |
| School of Dental Medicine |
| PennDesign |
| School of Medicine |
| Social Policy and Practice |
| School of Veterinary Medicine |

| Q4. How old are you? |
|---|
| 17, or younger |
| 18 |
| 19 |
| 20 |
| 21 |
| 22 |
| 23 |
| 24, or older |

| Q5. Sex |
|---|
| Female |
| Male |

| Q6. What US political party do you most associate with? |
|---|
| Republican |
| Democrat |
| Independent |
| None of the above |

| Q7. Please answer yes or no to the following questions: | | |
|---|---|---|
| | Yes | No |
| Are you an Environmental Studies Major? | | |
| Are you an Environmental Studies Minor? | | |
| Have you taken an Environmental Studies class? | | |
| Have you taken a class regarding environmental sustainability at Penn? | | |
| Are you a member of the Penn Environmental Group? | | |
| Are you a member of the Green Campus Partnership? | | |
| Do you belong to any sort of environmental group, either at home or campus? | | |

| Q8. Did you ever pay for your own electricity before College? |
|---|
| Yes |
| No |

| Q9. If yes, how long? |
|---|
| Weeks |
| Months |
| A Year |
| 2 or more years |
| Always |

| Q10. How big was your house that you grew up in? |
|---|
| 1-2 bedrooms |
| 2-3 bedrooms |
| 4 or more bedrooms |

| Q11. What region of the United States are you from? |
|---|
| Northeast |
| Midwest |
| South |
| West |
| Other Country (Please Specify) |

| Q12. What college house do you live in? |
|---|
| W.E.B. Du Bois College House |
| Fisher Hassenfeld College House |
| Gregory College House |
| Harnwell College House |
| Harrison College House |
| Hill College House |
| Kings Court English House College House |
| Riepe College House |
| Rodin College House |
| Stouffer College House |
| Ware College House |
| Other |

| Q13. Type of Room |
|---|
| Single |
| Double |
| Triple |
| Quad |
| Other |

## Sustainability Background Information

| Q14. Are you concerned about the environment? |
|---|
| Not at all |
| A little |
| Somewhat |
| Very |
| Extremely |

| Q15. What environmental issues are most important to you? | | | | | |
|---|---|---|---|---|---|
| | 1 (Most Important) | 2 | 3 | 4 | 5 (Least Important) |
| Greenhouse gas levels and climate change | | | | | |
| Water conservation | | | | | |
| Water quality and storm water | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Bio-diversity, vegetation, and habitat | | | | | |
| Waste and recycling | | | | | |

| Q16. Where have you learned about living more sustainable (how to recycle, energy conservation, etc.)? (Check all that apply) |
|---|
| Elementary School |
| Middle School |
| High School |
| College |
| Home/Family |
| Peers/Friends |
| TV |
| Paper media (books, newspapers, magazines, etc.) |
| Radio |
| Internet |
| Government/Non-profit companies/Special interest groups |
| For-profit companies |
| Other |

| Q17. If you have learned about living more sustainable at Penn, where specifically? (Check all that apply) |
|---|
| Amy Gutmann |
| Green Campus Partnership |
| Professor/Teaching Assistant/From Class |
| On-campus environmental group |
| Peers/Friends |
| Resident Advisor |
| House Dean |
| Facilities employee |
| Other Penn employee |
| Other |

| Q18. Please rate personal level of | | | | | |
|---|---|---|---|---|---|
| | 1 (Low) | 2 | 3 (Average) | 4 | 5 (High) |
| Living sustainably | | | | | |
| Energy consumption | | | | | |

| Q19. Penn should be more sustainable: |
|---|
| Agree |
| Disagree |

| Q20. How willing are you to change your habits to help the University to lower its energy consumption? |
|---|
| Not at all |
| A little |
| Somewhat |
| Very |
| Extremely |

| Q21. Are you aware of standby/vampire/phantom power? |
|---|
| Yes, and I do something about it |
| Yes, but I do little to nothing about it |
| No |

## Energy Conservation Initiatives

| Q22. How do you feel about Penn coming in 45th out of 135 in the Sierra Club's "Cool Schools 2009," which looks at a variety of issues that deal with sustainability including academics, energy, purchasing, and food? University of Colorado (Boulder) was 1st, Harvard University was 11th, Brown University was 64th, and University of Georgia was 115th |
|---|
| Ashamed |
| Frustrated |
| Okay |
| Great |
| Indifferent |

| Q23. Please rate: | | | | |
|---|---|---|---|---|
| | Not at all | A little | Somew hat | Very |

| | | | | |
|---|---|---|---|---|
| How much do these rankings affect your view of how Penn is doing against other schools in regard to sustainability? | | | | |
| Are you willing to change your behavior to achieve a higher sustainability grade? | | | | |

| Q24. Please answer the following questions: | | |
|---|---|---|
| Yes/No | Yes | No |
| Would you be willing to pay for a University provided sustainable energy appliance in your room (eg. upgrade outdated overhead lighting with a more efficient fixture)? | | |
| Would you be willing to pay an optional fee to offset a portion of your carbon footprint while living on campus? This money would be used to fund sustainable living initiatives chosen by Student Government | | |
| Would you be willing to contribute to a sustainable energy initiatives fund? This fund would sponsor the upgrade of various high-energy-consuming mechanical devices that heat and cool buildings around campus. | | |

| How much? | None | 10 | 20 | 50 | 100 | More than $100 |
|---|---|---|---|---|---|---|
| Would you be willing to pay for a University provided sustainable energy appliance in your room (eg. upgrade outdated overhead lighting with a more efficient fixture)? | | | | | | |
| Would you be willing to pay an optional fee to offset a portion of your carbon footprint while living on campus? This money would be used to fund sustainable living initiatives chosen by Student Government | | | | | | |
| Would you be willing to contribute to a sustainable energy initiatives fund? This fund would sponsor the upgrade of various high-energy-consuming mechanical devices that heat and cool | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| buildings around campus. | | | | | | |
| How much? | N/A | Personal Responsibility ("its the right thing to do") | Climate Change | Better for the environment | Pressure from others | Other |
| Would you be willing to pay for a University provided sustainable energy appliance in your room (eg. upgrade outdated overhead lighting with a more efficient fixture)? | | | | | | |
| Would you be willing to pay an optional fee to offset a portion of your carbon footprint while living on campus? This money would be used to fund sustainable living initiatives chosen by Student Government | | | | | | |
| Would you be willing to contribute to a sustainable energy initiatives fund? This fund would sponsor the upgrade of various high-energy-consuming mechanical devices that heat and cool buildings around campus. | | | | | | |

| Q25. What are your barriers towards consuming less electricity? (Check all that apply) |
|---|
| Accurate knowledge (eg. I don't know why I should choose a LCD TV over a Plasma, etc.) |
| Monetary constraints (eg. unwilling to purchase a $4 light bulb, etc.) |
| Replacing current appliances (eg. my TV still works, so why upgrade?, etc.) |
| Willingness to do something/Laziness (eg. too much work and time to turn off the TV when I leave a room, etc.) |
| Effect on lifestyle (eg. I need to have my computer on all the time just in case something comes up, etc.) |
| Do not care about consuming less energy |
| Other |

| Q26. Do the following groups support the initiative of living more sustainable? (Check all that apply) |
|---|
| None |
| Siblings (if applicable) |
| Parents |
| Grandparents |
| Other students |
| Professors |
| The University |
| Hometown |

## University Initiatives

| Q27. What do you do to reduce your electricity consumption? Check the following: |
|---|
| Turn off/put to sleep appliances that are you are not using |
| Turn off the lights when you leave a room |
| Unplug appliances/ turn off the surge protector |
| Open a window instead of using a fan or air-conditioning |
| Use task lighting (only have lighting for areas that you are using) |
| Use energy star products |
| Do not purposely have electricity intensive appliances in room (refrigerator, microwave, etc.) |
| Replaced incandescent bulbs with CFLs |
| Nothing |
| Other (please specify) |

| Q28. Are you aware of the following? | | | |
|---|---|---|---|
| | Yes | A little | No |
| Penn's Climate Action Plan | | | |
| Penn's wind power purchases | | | |
| Green Campus Partnership | | | |
| Penn Environmental Group | | | |
| 5% Energy Reduction Goal | | | |
| CFL Exchange | | | |

| | | | | | |
|---|---|---|---|---|---|
| Big Belly (Solar Power) Trash Cans | | | | | |

| Q29. If implemented, how effective would these initiatives be to lower energy consumption at Penn: | | | | | |
|---|---|---|---|---|---|
| | Not at all | A little | Somew hat | A lot | Extrem ely |
| Energy Monitoring of rooms to allow data collection of energy consumption. | | | | | |
| Increase tuition to offset energy consumption. | | | | | |
| Replace incandescent bulbs with compact fluorescents bulbs. | | | | | |
| Electricity bill for students living on campus. Electricity would be monitored each month and students would be charged for electricity consumption. | | | | | |
| Sample energy efficient and "green" dorm room. Tours of the room would be given to educate the Penn community about the potential greenhouse-gas-emissions reductions and financial benefits of being smart consumers. | | | | | |
| Environmental Education Center on Campus to hand out materials on sustainable living, set up sustainable living information sessions, and provide an on-campus resource for all environment related questions. | | | | | |
| Sustainability workshop during New Student Orientation to inform students of their potential impact and what they can do to reduce it. | | | | | |
| Subsidies to purchase energy star (low energy consuming) products (eg. $20 rebate to purchase an energy efficient refrigerator at the bookstore, etc.). | | | | | |
| Education Campaign about ways students lowering energy use (eg. RAs/GAs telling their students about how reduce their consumption, etc.). | | | | | |
| Subsidies for students not to bring certain energy “hogs” (eg. The University would give you a $20 rebate for not having a refrigerator, etc.). | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lowering rent for students who use less electricity and other forms of electricity. | | | | | | |
| Have periodical competitions between College Houses to consume less energy. Some sort of reward would be given to the College House that consumed the least amount. | | | | | | |
| Have events and promotions that demonstrate energy conservation and sustainable lifestyles. | | | | | | |
| Have a social marketing campaign that promotes energy conservation and sustainable lifestyles. | | | | | | |

| Q30. Who has sent you messages about living more sustainably? (Check all that apply) |
|---|
| Amy Gutmann |
| Green Campus Partnership |
| Professor/Teaching Assistant/From Class |
| On-campus environmental group |
| Peers/Friends |
| Resident Advisor |
| House Dean |
| Facilities employee |
| Other Penn affiliated people |
| Family |
| Websites |
| Newspapers |
| Government |
| Other |

| Q31. How impactful are these messages? |
|---|
| Not at all |
| A little |
| Somewhat |
| Very |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q32. How would you prefer to be informed about sustainability issues and becoming more sustainable? (Please Rank) | | | | | | |

| | Do not wish to be informed | 1 (Bad way) | 2 | 3 | 4 | 5 (Great way) |
|---|---|---|---|---|---|---|
| Internet | | | | | | |
| Advertising campaign | | | | | | |
| Peers/Friends | | | | | | |
| Workshops and seminars | | | | | | |
| University leaders | | | | | | |
| University events | | | | | | |
| Newsletter – Mail or email | | | | | | |
| Getting practical advice from your RA/GA or House Dean (e.g. energy audits) | | | | | | |

| Q33. Do you have any other suggestions for how to lower electricity consumption in student housing? |
|---|
| Yes |
| No |

## Thanks!

Thanks for taking the survey.

Also, if you know someone who lives in student housing could you ask them to take it too or ask a RA/GA to pass it on their residents. Just forward the original link you received to them.

In addition to my survey, I performing numerous energy audits (measuring electricity in people's rooms and asking a few simple questions) to see current electrical consumption. The audit should take no more than 10 minutes. If you wish to volunteer, please answer "Yes" to the question below and put your email address. You will be contacted shortly with further instructions.

Please look out for an email to see if you won the $50 cash prize.

Thanks again!

| Q35. Do you wish to volunteer for an energy audit/already participated in an energy audit? (If yes, please put your email address) |
|---|
| Yes |
| No |
| Email |

**B. Survey Results**

## Background Info

| Q1. At Penn, I am a: | |
|---|---|
| | Response Percent |
| Undergraduate Student | 94.6% |
| Graduate Student | 5.0% |
| House Dean | 0.5% |
| Other Faculty Person | 0.0% |
| Other | 0.0% |

| Q2. What year do you expect to graduate? | |
|---|---|
| | Response Percent |
| 2010 | 15.8% |
| 2011 | 15.8% |
| 2012 | 22.6% |
| 2013 | 45.2% |
| N/A | 0.6% |

| Q3. What School(s) are you in? | |
|---|---|
| | Response Percent |
| School of Arts and Sciences | 67.4% |
| The Wharton School of Business | 16.7% |
| School of Engineering and Applied Science | 14.0% |
| School of Nursing | 5.4% |
| Annenberg School of | 0.5% |

| | |
|---|---|
| Communication | |
| Graduate School of Arts and Sciences | 0.5% |
| Graduate School of Education | 2.3% |
| Law School | 0.0% |
| School of Dental Medicine | 0.9% |
| PennDesign | 0.0% |
| School of Medicine | 0.0% |
| Social Policy and Practice | 0.5% |
| School of Veterinary Medicine | 0.0% |

| Q4. How old are you? | |
|---|---|
| | Response Percent |
| 17, or younger | 4.5% |
| 18 | 29.4% |
| 19 | 29.0% |
| 20 | 18.6% |
| 21 | 12.2% |
| 22 | 1.4% |
| 23 | 0.5% |
| 24, or older | 4.5% |

| Q5. Sex | |
|---|---|
| | Response Percent |
| Female | 63.3% |
| Male | 37.1% |

| Q6. What US political party do you most associate with? | |
|---|---|
| | Response Percent |
| Republican | 12.7% |
| Democrat | 52.5% |
| Independent | 13.6% |
| None of the above | 21.3% |

| Q7. Please answer yes or no to the following | | |
|---|---|---|

| questions: | | |
|---|---|---|
| | Response Percent | |
| | Yes | No |
| Are you an Environmental Studies Major? | 5.1% | 94.9% |
| Are you an Environmental Studies Minor? | 0.9% | 99.1% |
| Have you taken an Environmental Studies class? | 19.0% | 81.0% |
| Have you taken a class regarding environmental sustainability at Penn? | 5.1% | 94.9% |
| Are you a member of the Penn Environmental Group? | 10.2% | 89.8% |
| Are you a member of the Green Campus Partnership? | 4.2% | 95.8% |
| Do you belong to any sort of environmental group, either at home or campus? | 18.5% | 81.5% |

| Q8. Did you ever pay for your own electricity before College? | |
|---|---|
| | Response Percent |
| Yes | 6.3% |
| No | 93.7% |

| Q9. If yes, how long? | |
|---|---|
| | Response Percent |
| Weeks | 0.0% |
| Months | 20.0% |
| A Year | 6.7% |
| 2 or more years | 46.7% |
| Always | 26.7% |

| Q10. How big was your | |
|---|---|

| house that you grew up in? | |
|---|---|
| | Response Percent |
| 1-2 bedrooms | 8.6% |
| 2-3 bedrooms | 35.5% |
| 4 or more bedrooms | 55.7% |

| Q11. What region of the United States are you from? | |
|---|---|
| | Response Percent |
| Northeast | 54.8% |
| Midwest | 10.0% |
| South | 10.0% |
| West | 10.4% |
| Other Country (Please Specify) | 14.9% |

| Q12. What college house do you live in? | |
|---|---|
| | Response Percent |
| W.E.B. Du Bois College House | 9.0% |
| Fisher Hassenfeld College House | 6.8% |
| Gregory College House | 5.0% |
| Harnwell College House | 3.2% |
| Harrison College House | 9.0% |
| Hill College House | 3.2% |
| Kings Court English House College House | 14.0% |
| Riepe College House | 2.7% |
| Rodin College House | 1.3% |
| Stouffer College House | 24.9% |
| Ware College House | 7.7% |
| Other | 1.8% |

| Q13. Type of Room | |
|---|---|
| | Response Percent |
| Single | 30.3% |

| | |
|---|---|
| Double | 39.8% |
| Triple | 12.2% |
| Quad | 17.2% |
| Other | 0.5% |

## Sustainability Background Information

| Q14. Are you concerned about the environment? | |
|---|---|
| | Response Percent |
| Not at all | 0.5% |
| A little | 8.2% |
| Somewhat | 39.4% |
| Very | 39.9% |
| Extremely | 12.0% |

| Q15. What environmental issues are most important to you? | | | | | |
|---|---|---|---|---|---|
| | Total Respondents | | | | |
| | 1 (Most Important) | 2 | 3 | 4 | 5 (Least Important) |
| Greenhouse gas levels and climate change | 60 | 37 | 38 | 39 | 34 |
| Water conservation | 30 | 56 | 55 | 44 | 23 |
| Water quality and storm water | 16 | 40 | 39 | 49 | 64 |
| Bio-diversity, vegetation, and habitat | 33 | 25 | 46 | 47 | 57 |
| Waste and recycling | 69 | 50 | 30 | 29 | 30 |
| | Response Percent | | | | |
| Greenhouse gas levels and climate change | 28.8% | 17.8% | 18.3% | 18.8% | 16.3% |
| Water conservation | 14.4% | 26.9% | 26.4% | 21.2% | 11.1% |
| Water quality and storm water | 7.7% | 19.2% | 18.8% | 23.6% | 30.8% |
| Bio-diversity, vegetation, | 15.9% | 12.0% | 22.1% | 22.6% | 27.4% |

| | | | | | |
|---|---|---|---|---|---|
| and habitat | | | | | |
| Waste and recycling | 33.2% | 24.0% | 14.4% | 13.9% | 14.4% |

| Q16. Where have you learned about living more sustainable (how to recycle, energy conservation, etc.)? (Check all that apply) | |
|---|---|
| | Response Percent |
| Elementary School | 52.4% |
| Middle School | 55.8% |
| High School | 77.8% |
| College | 58.2% |
| Home/Family | 64.9% |
| Peers/Friends | 50.0% |
| TV | 53.8% |
| Paper media (books, newspapers, magazines, etc.) | 61.5% |
| Radio | 17.8% |
| Internet | 62.5% |
| Government/Non-profit companies/Special interest groups | 41.3% |
| For-profit companies | 9.1% |
| Other | 1.4% |

| Q17. If you have learned about living more sustainable at Penn, where specifically? (Check all that apply) | |
|---|---|
| | Response Percent |
| Amy Gutmann | 11.5% |
| Green Campus Partnership | 22.1% |
| Professor/Teaching Assistant/From Class | 22.9% |
| On-campus environmental group | 47.3% |
| Peers/Friends | 57.3% |
| Resident Advisor | 16.0% |

| | |
|---|---|
| House Dean | 13.7% |
| Facilities employee | 3.8% |
| Other Penn employee | 3.8% |
| Other | 6.1% |

| Q18. Please rate personal level of | | | | | |
|---|---|---|---|---|---|
| | Response Percent | | | | |
| | 1 (Low) | 2 | 3 (Average) | 4 | 5 (High) |
| Living sustainably | 1.9% | 5.8% | 54.9% | 29.6% | 7.8% |
| Energy consumption | 2.9% | 20.9% | 55.3% | 18.9% | 1.9% |

| Q19. Penn should be more sustainable: | |
|---|---|
| | Response Percent |
| Agree | 95.2% |
| Disagree | 4.8% |

| Q20. How willing are you to change your habits to help the University to lower its energy consumption? | |
|---|---|
| | Response Percent |
| Not at all | 2.9% |
| A little | 12.5% |
| Somewhat | 36.5% |
| Very | 35.6% |
| Extremely | 12.5% |

| Q21. Are you aware of standby/vampire/phantom power? | |
|---|---|
| | Response Percent |
| Yes, and I do something about it | 23.1% |
| Yes, but I do little to nothing about it | 23.6% |
| No | 53.4% |

# Energy Conservation Initiatives

| Q22. How do you feel about Penn coming in 45th out of 135 in the Sierra Club's "Cool Schools 2009," which looks at a variety of issues that deal with sustainability including academics, energy, purchasing, and food? University of Colorado (Boulder) was 1st, Harvard University was 11th, Brown University was 64th, and University of Georgia was 115th | |
|---|---|
| | Response Percent |
| Ashamed | 11.1% |
| Frustrated | 15.6% |
| Okay | 42.7% |
| Great | 3.5% |
| Indifferent | 27.1% |

| Q23. Please rate: | | | | |
|---|---|---|---|---|
| | Response Percent | | | |
| | Not at all | A little | Somewhat | Very |
| How much do these rankings affect your view of how Penn is doing against other schools in regard to sustainability? | 18.6% | 35.7% | 36.7% | 9.0% |
| Are you willing to change your behavior to achieve a higher sustainability grade? | 8.0% | 19.6% | 46.7% | 25.6% |

| Q24. Please answer the | | |
|---|---|---|

| following questions: | | |
|---|---|---|
| | Response Percent | |
| Yes/No | Yes | No |
| Would you be willing to pay for a University provided sustainable energy appliance in your room (eg. upgrade outdated overhead lighting with a more efficient fixture)? | 54.8% | 45.2% |
| Would you be willing to pay an optional fee to offset a portion of your carbon footprint while living on campus? This money would be used to fund sustainable living initiatives chosen by Student Government | 43.7% | 56.3% |
| Would you be willing to contribute to a sustainable energy initiatives fund? This fund would sponsor the upgrade of various high-energy-consuming mechanical devices that heat and cool buildings around campus. | 49.7% | 50.3% |

| | Response Percent | | | | | |
|---|---|---|---|---|---|---|
| How much? | None | 10 | 20 | 50 | 100 | More than $100 |
| Would you be willing to pay for a University provided sustainable energy appliance in your room (eg. upgrade outdated overhead lighting with a more efficient fixture)? | 40.7% | 20.3% | 25.3% | 9.9% | 1.6% | 2.2% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Would you be willing to pay an optional fee to offset a portion of your carbon footprint while living on campus? This money would be used to fund sustainable living initiatives chosen by Student Government | 52.0% | 18.6% | 15.3% | 9.6% | 1.7% | 2.3% |
| Would you be willing to contribute to a sustainable energy initiatives fund? This fund would sponsor the upgrade of various high-energy-consuming mechanical devices that heat and cool buildings around campus. | 44.8% | 27.1% | 17.1% | 6.6% | 2.2% | 2.2% |
| | Response Percent | | | | | |
| How much? | N/A | Personal Responsibility ("its the right thing to do") | Climate Change | Better for the environment | Pressure from others | Other |
| Would you be willing to pay for a University provided sustainable energy appliance in your room (eg. upgrade outdated overhead lighting with a more efficient fixture)? | 37.9% | 24.7% | 1.6% | 31.3% | 1.1% | 3.3% |
| Would you be willing to pay an optional fee to offset a portion of your carbon footprint while living on campus? This money would be used to fund sustainable living initiatives chosen by Student Government | 45.4% | 19.5% | 6.9% | 19.5% | 1.1% | 4.0% |
| Would you be willing to contribute to a sustainable energy initiatives fund? This | 42.0% | 19.3% | 3.4% | 27.8% | 2.3% | 5.1% |

| | | | | | | |
|---|---|---|---|---|---|---|
| fund would sponsor the upgrade of various high-energy-consuming mechanical devices that heat and cool buildings around campus. | | | | | | |

| Q25. What are your barriers towards consuming less electricity? (Check all that apply) | |
|---|---|
| | Response Percent |
| Accurate knowledge (eg. I don't know why I should choose a LCD TV over a Plasma, etc.) | 39.2% |
| Monetary constraints (eg. unwilling to purchase a $4 light bulb, etc.) | 56.3% |
| Replacing current appliances (eg. my TV still works, so why upgrade?, etc.) | 57.3% |
| Willingness to do something/Laziness (eg. too much work and time to turn off the TV when I leave a room, etc.) | 20.6% |
| Effect on lifestyle (eg. I need to have my computer on all the time just in case something comes up, etc.) | 40.7% |
| Do not care about consuming less energy | 4.5% |
| Other | 7.0% |

| Q26. Do the following groups support the initiative of living more sustainable? (Check all that apply) | |
|---|---|
| | Response Percent |

| | |
|---|---|
| None | 7.5% |
| Siblings (if applicable) | 38.7% |
| Parents | 58.8% |
| Grandparents | 8.5% |
| Other students | 64.8% |
| Professors | 39.7% |
| The University | 56.8% |
| Hometown | 24.6% |

## University Initiatives

| Q27. What do you do to reduce your electricity consumption? Check the following: | |
|---|---|
| | Response Percent |
| Turn off/put to sleep appliances that are you are not using | 80.4% |
| Turn off the lights when you leave a room | 93.1% |
| Unplug appliances/ turn off the surge protector | 31.7% |
| Open a window instead of using a fan or air-conditioning | 63.0% |
| Use task lighting (only have lighting for areas that you are using) | 64.6% |
| Use energy star products | 36.0% |
| Do not purposely have electricity intensive appliances in room (refrigerator, microwave, etc.) | 18.0% |
| Replaced incandescent bulbs with CFLs | 45.5% |
| Nothing | 1.1% |

| | |
|---|---|
| Other (please specify) | 1.1% |

| Q28. Are you aware of the following? | | | |
|---|---|---|---|
| | Response Percent | | |
| | Yes | A little | No |
| Penn's Climate Action Plan | 21.7% | 27.5% | 50.8% |
| Penn's wind power purchases | 14.8% | 11.6% | 73.5% |
| Green Campus Partnership | 22.2% | 30.7% | 47.1% |
| Penn Environmental Group | 42.6% | 32.3% | 24.9% |
| 5% Energy Reduction Goal | 13.4% | 16.9% | 69.4% |
| CFL Exchange | 19.7% | 12.7% | 67.6% |
| Big Belly (Solar Power) Trash Cans | 39.2% | 21.2% | 39.7% |

| Q29. If implemented, how effective would these initiatives be to lower energy consumption at Penn: | | | | | |
|---|---|---|---|---|---|
| | Response Percent | | | | |
| | Not at all | A little | Somewhat | A lot | Extremely |
| Energy Monitoring of rooms to allow data collection of energy consumption. | 8.5% | 20.2% | 33.0% | 22.9% | 15.4% |
| Increase tuition to offset energy consumption. | 53.2% | 21.3% | 14.9% | 5.9% | 4.8% |
| Replace incandescent bulbs with compact fluorescents bulbs. | 2.1% | 6.9% | 27.7% | 40.4% | 22.9% |
| Electricity bill for students living on campus. Electricity would be monitored each month and students would be charged for electricity | 19.0% | 13.2% | 17.5% | 22.2% | 28.0% |

| | | | | | |
|---|---|---|---|---|---|
| consumption. | | | | | |
| Sample energy efficient and "green" dorm room. Tours of the room would be given to educate the Penn community about the potential greenhouse-gas-emissions reductions and financial benefits of being smart consumers. | 6.9% | 31.2% | 33.9% | 20.1% | 7.9% |
| Environmental Education Center on Campus to hand out materials on sustainable living, set up sustainable living information sessions, and provide an on-campus resource for all environment related questions. | 16.4% | 36.5% | 31.2% | 11.6% | 4.2% |
| Sustainability workshop during New Student Orientation to inform students of their potential impact and what they can do to reduce it. | 12.8% | 29.3% | 31.9% | 19.7% | 6.4% |
| Subsidies to purchase energy star (low energy consuming) products (eg. $20 rebate to purchase an energy efficient refrigerator at the bookstore, etc.). | 4.2% | 13.2% | 29.6% | 37.0% | 15.9% |
| Education Campaign about ways students lowering energy use (eg. RAs/GAs telling their students about how reduce their consumption, etc.). | 8.0% | 27.1% | 36.7% | 23.4% | 4.8% |
| Subsidies for students not to bring certain energy “hogs” (eg. The | 13.8% | 21.3% | 30.9% | 19.1% | 14.9% |

| | | | | | |
|---|---|---|---|---|---|
| University would give you a $20 rebate for not having a refrigerator, etc.). | | | | | |
| Lowering rent for students who use less electricity and other forms of electricity. | 4.2% | 6.3% | 16.4% | 23.3% | 49.7% |
| Have periodical competitions between College Houses to consume less energy. Some sort of reward would be given to the College House that consumed the least amount. | 6.3% | 22.2% | 26.5% | 29.6% | 15.3% |
| Have events and promotions that demonstrate energy conservation and sustainable lifestyles. | 12.7% | 29.6% | 30.2% | 19.0% | 3.2% |
| Have a social marketing campaign that promotes energy conservation and sustainable lifestyles. | 11.3% | 31.7% | 40.9% | 10.8% | 5.4% |

| Q30. Who has sent you messages about living more sustainably? (Check all that apply) | |
|---|---|
| | Response Percent |
| Amy Gutmann | 37.6% |
| Green Campus Partnership | 25.9% |
| Professor/Teaching Assistant/From Class | 9.5% |
| On-campus environmental group | 37.6% |
| Peers/Friends | 31.7% |
| Resident Advisor | 16.4% |
| House Dean | 20.6% |
| Facilities employee | 6.3% |

| | |
|---|---|
| Other Penn affiliated people | 12.7% |
| Family | 21.2% |
| Websites | 27.0% |
| Newspapers | 20.1% |
| Government | 16.9% |
| Other | 5.3% |

| Q31. How impactful are these messages? | |
|---|---|
| | Response Percent |
| Not at all | 18.5% |
| A little | 40.2% |
| Somewhat | 38.1% |
| Very | 3.2% |

| Q32. How would you prefer to be informed about sustainability issues and becoming more sustainable? (Please Rank) | | | | | | |
|---|---|---|---|---|---|---|
| | Response Percent | | | | | |
| | Do not wish to be informed | 1 (Bad way) | 2 | 3 | 4 | 5 (Great way) |
| Internet | 13.8% | 3.2% | 15.4% | 18.6% | 23.9% | 25.0% |
| Advertising campaign | 16.5% | 9.0% | 17.0% | 28.7% | 18.6% | 10.1% |
| Peers/Friends | 10.6% | 3.7% | 8.0% | 22.9% | 29.3% | 25.5% |
| Workshops and seminars | 15.0% | 15.5% | 27.8% | 21.9% | 12.8% | 7.0% |
| University leaders | 10.9% | 10.3% | 26.1% | 22.3% | 21.7% | 8.7% |
| University events | 11.2% | 7.4% | 20.7% | 26.1% | 22.3% | 12.2% |
| Newsletter – Mail or email | 16.2% | 15.7% | 23.2% | 22.7% | 16.2% | 5.9% |
| Getting practical advice from your RA/GA or House Dean (e.g. energy | 10.8% | 8.6% | 13.4% | 24.7% | 23.1% | 19.4% |

| | | | | | | |
|---|---|---|---|---|---|---|
| audits) | | | | | | |

| Q33. Do you have any other suggestions for how to lower electricity consumption in student housing? | |
|---|---|
| | Response Count |
| Answered question | 28 |

## Thanks!

| Q34. Do you wish to volunteer for an energy audit/already participated in an energy audit? (If yes, please put your email address) | |
|---|---|
| | Response Count |
| Yes | 35 |

**C. Energy Audit Assumptions**

i. Refrigerators

| Refrigerator | | |
|---|---|---|
| 600 kWh/year | 500 kWh/year | 400 kWh/year |
| Old Medium | Old Small | Old Mini |
| New Large | New Medium | New Small |

Source: Home Depot. "Hotpoint 16.6 Cu. Ft. Top Freezer Refrigerator," from http://www.homedepot.com/Featured-Products-Appliances-Refrigeration-Refrigerators/h_d1/N-5yc1vZ1xr5Zbcnq/R-100664369/h_d2/ProductDisplay?langId=-1&storeId=10051&catalogId=10053

ii. Mini-refrigerators

| Mini-refrigerator | | |
|---|---|---|
| 375 kWh/year | 334 kWh/year | 292 kWh/year |
| Old (3+ years) | Medium Size | New (<1 years) |
| | Energy Star Large | Energy Star |
| (Average number) | | |

Source: Home Depot. "GE Spacemaker 4.3 Cu. Ft. Compact Refrigerator," from http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10051&productId=100656793&langId=-1&catalogId=10053&ci_src=14110944&ci_sku=100656793&cm_mmc=shopping-_-googlebase-_-D29X-_-100656793

## D. Individual Room Audits

| Person 1 | Person 1 |
|---|---|
| Room Type | Single |
| Kitchen | No |
| How does your energy use on campus compare to that | Lower |
| Do you unplug appliances/turn off surge when not in | Yes |
| How do you percieve your energy use to be? | Average |

| | | | Full On | | Idle | | Energy Consumption | | Totals | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Items | Quantity | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
| | | | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Refrigerator | Mini Refrigerator | 1 | 292 | 24 | 0 | 0 | 7008 | 0 | 7008 | 1667.904 | $ 166.79 | 0 | $ - |
| Microwave | Kenmore Microwave | 1 | 900 | 0.07 | 1 | 23.93 | 63 | 0 | 63 | 14.994 | $ 1.50 | 0 | $ - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 20 | 2.5 | 0 | 21.5 | 50 | 0 | 50 | 11.9 | $ 1.19 | 0 | $ - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 60 | 2 | 0 | 22 | 120 | 0 | 120 | 28.56 | $ 2.86 | 0 | $ - |
| Phone Charger | Phone Charger | 1 | 3 | 1 | 1 | 23 | 3 | 23 | 26 | 6.188 | $ 0.62 | 5.474 | $ 0.55 |
| Computer | Lenovo Computer | 1 | 40 | 2 | 0 | 22 | 80 | 0 | 80 | 19.04 | $ 1.90 | 0 | $ - |
| Television | Toshiba 12 inches | 1 | 45 | 7.5 | 1 | 16.5 | 337.5 | 16.5 | 354 | 84.252 | $ 8.43 | 3.927 | $ 0.39 |
| Alarm Clock | Clock Radio | 1 | 3 | 24 | 0 | 0 | 72 | 0 | 72 | 17.136 | $ 1.71 | 0 | $ - |
| Other | Humidifier | 1 | 130 | 8.5 | 0 | 15.5 | 1105 | 0 | 1105 | 262.99 | $ 26.30 | 0 | $ - |
| Other | Answering Machine | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 48 | 11.424 | $ 1.14 | 0 | $ - |
| Overhead Light | Overhead Light | 1 | 12 | 3 | 0 | 21 | 36 | 0 | 36 | 8.568 | $ 0.86 | 0 | $ - |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | Total | 11 | 1507 | 98.57 | 3 | 165.43 | 8922.5 | 39.5 | 8962 | 2132.956 | 213.2956 | 9.401 | $ 0.94 |

| Person 2 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Single | | | | | | | | | | | | | |
| Kitchen | No | | | | | | | | | | | | | |
| How does your energy use on campus compare to that at home? | Lower | | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in use? | No | | | | | | | | | | | | | |
| How do you percieve your energy use to be? | Average | | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Mini Refrigerator | 1 | 334 | 24 | 0 | 0 | 8016 | 0 | 8016 | 1907.808 | $ 190.78 | 0 | $ | - |
| Microwave | Microwave | 1 | 1000 | 0.07 | 1 | 23.93 | 70 | 0 | 70 | 16.66 | $ 1.67 | 0 | $ | - |
| Fluorescent Desk Lamp | Desk Lamp | 1 | 60 | 1 | 0 | 23 | 60 | 0 | 60 | 14.28 | $ 1.43 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 2 | 1.5 | 1 | 22.5 | 3 | 22.5 | 25.5 | 6.069 | $ 0.61 | 5.355 | $ | 0.54 |
| Computer | Dell Computer | 1 | 29 | 2 | 1 | 22 | 58 | 22 | 80 | 19.04 | $ 1.90 | 5.236 | $ | 0.52 |
| Television | TV | 1 | 47 | 7.5 | 0.4 | 16.5 | 352.5 | 6.6 | 359.1 | 85.4658 | $ 8.55 | 1.5708 | $ | 0.16 |
| Alarm Clock | Clock Radio | 1 | 3 | 24 | 0 | 0 | 72 | 0 | 72 | 17.136 | $ 1.71 | 0 | $ | - |
| Overhead Light | Overhead Light | 1 | 12 | 3 | 0 | 21 | 36 | 0 | 36 | 8.568 | $ 0.86 | 0 | $ | - |
| Overhead Light | Bathroom Light | 1 | 14 | 1 | 0 | 23 | 14 | 0 | 14 | 3.332 | $ 0.33 | 0 | $ | - |
| Speakers | iHome | 1 | 15 | 1 | 3 | 23 | 15 | 69 | 84 | 19.992 | $ 2.00 | 16.422 | $ | 1.64 |
| Printer | Printer | 1 | 40 | 0.02 | 7 | 23.98 | 0.8 | 167.86 | 168.66 | 40.14108 | $ 4.01 | 39.95068 | $ | 4.00 |
| Kitchen Appliance | Coffee Machine | 1 | 35 | 0.13 | 1 | 23.87 | 4.55 | 0 | 4.55 | 1.0829 | $ 0.11 | 0 | $ | - |
| Bathroom Appliance | Straightner | 1 | 200 | 0.16 | 1 | 23.84 | 32 | 23.84 | 55.84 | 13.28992 | $ 1.33 | 5.67392 | $ | 0.57 |
| Bathroom Appliance | Hair Dryer | 1 | 582 | 0.16 | 0 | 23.84 | 93.12 | 0 | 93.12 | 22.16256 | $ 2.22 | 0 | $ | - |
| Overhead Light | Overhead Light | 1 | 14 | 3.5 | 0 | 20.5 | 49 | 0 | 49 | 11.662 | $ 1.17 | 0 | $ | - |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Total | 15 | 2387 | 69.04 | 15.4 | 290.96 | 8875.97 | 311.8 | 9187.77 | 2186.6893 | 218.668926 | 74.2084 | $ | 7.42 |

| Person 3 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Single | | | | | | | | | | | | | |
| Kitchen | No | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | Lower | | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | Yes | | | | | | | | | | | | | |
| How do you percieve your energy use to be? | Below | | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Mini Refrigerator | 1 | 334 | 24 | 0 | 0 | 8016 | 0 | 8016 | 1907.808 | $ 190.78 | 0 | $ | - |
| Microwave | Microwave | 1 | 900 | 0.03 | 1 | 23.97 | 27 | 0 | 27 | 6.426 | $ 0.64 | 0 | $ | - |
| Fluorescent Desk Lamp | Desk Lamp | 1 | 29 | 2.5 | 0 | 21.5 | 72.5 | 0 | 72.5 | 17.255 | $ 1.73 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 12 | 6 | 0 | 18 | 72 | 0 | 72 | 17.136 | $ 1.71 | 0 | $ | - |
| Computer | Macbook | 1 | 70 | 7 | 0 | 17 | 490 | 0 | 490 | 116.62 | $ 11.66 | 0 | $ | - |
| Speakers | iHome | 1 | 12 | 2 | 3 | 22 | 24 | 66 | 90 | 21.42 | $ 2.14 | 15.708 | $ | 1.57 |
| Bathroom Appliance | Toothbrush | 1 | 3 | 24 | 0 | 0 | 72 | 0 | 72 | 17.136 | $ 1.71 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 0 | 16 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ | - |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| | Total | 8 | 1362 | 73.53 | 4 | 118.47 | 8789.5 | 66 | 8855.5 | 2107.609 | 210.7609 | 15.708 | $ | 1.57 |

| Person 4 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Single | | | | | | | | | | | | | |
| Kitchen | No | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | Same | | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | No | | | | | | | | | | | | | |
| How do you percieve your energy use to be? | High | | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Mini Refrigerator | 1 | 400 | 24 | 0 | 0 | 9600 | 0 | 9600 | 2284.8 | $ 228.48 | 0 | $ | - |
| Microwave | Microwave | 1 | 1000 | 0.03 | 1 | 23.97 | 30 | 0 | 30 | 7.14 | $ 0.71 | 0 | $ | - |
| Incandescent Desk Lamp | Desk Lamp | 1 | 60 | 4 | 0 | 20 | 240 | 0 | 240 | 57.12 | $ 5.71 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 5 | 60 | 6 | 0 | 18 | 1800 | 0 | 1800 | 428.4 | $ 42.84 | 0 | $ | - |
| Computer | Dell | 1 | 26 | 6 | 0.4 | 18 | 156 | 7.2 | 163.2 | 38.8416 | $ 3.88 | 1.7136 | $ | 0.17 |
| Speakers | Speakers | 1 | 12 | 0.25 | 3 | 23.75 | 3 | 71.25 | 74.25 | 17.6715 | $ 1.77 | 16.9575 | $ | 1.70 |
| Bathroom Appliance | Hair Dryer | 1 | 582 | 0.02 | 0 | 23.98 | 11.64 | 0 | 11.64 | 2.77032 | $ 0.28 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 2 | 2 | 0.4 | 22 | 4 | 8.8 | 12.8 | 3.0464 | $ 0.30 | 2.0944 | $ | 0.21 |
| Printer | Printer | 1 | 30 | 0.02 | 0 | 23.98 | 0.6 | 0 | 0.6 | 0.1428 | $ 0.01 | 0 | $ | - |
| Incandescent Desk Lamp | Desk Lamp | 1 | 40 | 0.3 | 0 | 23.7 | 12 | 0 | 12 | 2.856 | $ 0.29 | 0 | $ | - |
| Alarm Clock | Alarm Clock | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 48 | 11.424 | $ 1.14 | 0 | $ | - |
| Television | TV | 1 | 45 | 0.5 | 0.4 | 23.5 | 22.5 | 9.4 | 31.9 | 7.5922 | $ 0.76 | 2.2372 | $ | 0.22 |
| Electronics | DVD Player | 1 | 12 | 0.02 | 1 | 23.98 | 0.24 | 23.98 | 24.22 | 5.76436 | $ 0.58 | 5.70724 | $ | 0.57 |
| Speakers | Stereo | 1 | 27 | 1.5 | 1 | 22.5 | 40.5 | 22.5 | 63 | 14.994 | $ 1.50 | 5.355 | $ | 0.54 |
| Overhead light | Overhead light | 1 | 12 | 1 | 0 | 23 | 12 | 0 | 12 | 2.856 | $ 0.29 | 0 | $ | - |
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| | Total | 19 | 2310 | 69.64 | 7.2 | 290.36 | 11980.48 | 143.13 | 12123.61 | 2885.4192 | 288.541918 | 34.06494 | $ | 3.41 |

Person 5

| | |
|---|---|
| Room Type | Double |
| Kitchen | No |
| How does your energy use on campus compare to that | Lower |
| Do you unplug appliances/turn off surge when not in | Yes |
| How do you percieve your energy use to be? | Below |

| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Refrigerator | Mini Refrigerator | 1 | 292 | 24 | 0 | 0 | 7008 | 0 | 3504 | 833.952 | $ 83.40 | 0 | $ - |
| Fluorescent Desk Lamp | Desk Lamp | 1 | 13 | 7 | 0 | 17 | 91 | 0 | 91 | 21.658 | $ 2.17 | 0 | $ - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 20 | 8 | 0 | 16 | 160 | 0 | 160 | 38.08 | $ 3.81 | 0 | $ - |
| Computer | Computer | 1 | 40 | 5.5 | 0 | 18.5 | 220 | 0 | 220 | 52.36 | $ 5.24 | 0 | $ - |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 0 | 16 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ - |
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| | | | | | | | | | | | | | |
| | Total | 5 | 367 | 52.5 | 0 | 67.5 | 7495 | 0 | 3991 | 949.858 | 94.9858 | 0 | $ - |

Person 6

| | |
|---|---|
| Room Type | Double |
| Kitchen | No |
| How does your energy use on campus compare to that | Lower |
| Do you unplug appliances/turn off surge when not in | No |
| How do you percieve your energy use to be? | Average |

| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Refrigerator | Mini Refrigerator | 1 | 292 | 24 | 0 | 0 | 7008 | 0 | 3504 | 833.952 | $ 83.40 | 0 | $ - |
| Fluorescent Desk Lamp | Desk Lamp | 1 | 14 | 4 | 0 | 20 | 56 | 0 | 56 | 13.328 | $ 1.33 | 0 | $ - |
| Overhead | Overhead light | 1 | 16 | 4 | 0 | 20 | 64 | 0 | 32 | 7.616 | $ 0.76 | 0 | $ - |
| Computer | Macbook | 1 | 55 | 4 | 1 | 20 | 220 | 20 | 240 | 57.12 | $ 5.71 | 4.76 | $ 0.48 |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 1 | 16 | 16 | 16 | 32 | 7.616 | $ 0.76 | 3.808 | $ 0.38 |
| Microwave | Microwave | 1 | 1000 | 0.08 | 1 | 23.92 | 80 | 0 | 40 | 9.52 | $ 0.95 | 0 | $ - |
| Alarm Clock | Clock Radio | 1 | 3 | 24 | 0 | 0 | 72 | 0 | 72 | 17.136 | $ 1.71 | 0 | $ - |
| Bathroom Appliance | Straightner | 1 | 200 | 0.08 | 0 | 23.92 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ - |
| Bathroom Appliance | Hair Dryer | 1 | 582 | 0.17 | 1 | 23.83 | 98.94 | 23.83 | 122.77 | 29.21926 | $ 2.92 | 5.67154 | $ 0.57 |
| Kitchen Appliance | Coffee Machine | 1 | 35 | 0.13 | 2 | 23.87 | 4.55 | 0 | 4.55 | 1.0829 | $ 0.11 | 0 | $ - |
| Electronics | External HD | 1 | 10 | 24 | 0 | 0 | 240 | 0 | 240 | 57.12 | $ 5.71 | 0 | $ - |
| Speakers | Speakers | 1 | 15 | 1 | 0 | 23 | 15 | 0 | 15 | 3.57 | $ 0.36 | 0 | $ - |
| Printer | Printer | 1 | 30 | 0.02 | 1 | 23.98 | 0.6 | 23.98 | 24.58 | 5.85004 | $ 0.59 | 5.70724 | $ 0.57 |
| Overhead | Overhead light | 1 | 14 | 4 | 0 | 20 | 56 | 0 | 28 | 6.664 | $ 0.67 | 0 | $ - |
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| | Total | 14 | 2268 | 97.48 | 7 | 238.52 | 7947.09 | 83.81 | 4426.9 | 1053.6022 | 105.36022 | 19.94678 | $ 1.99 |

| Person 7 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | No | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Higher | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Average | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Mini Refrigerator | 1 | 334 | 24 | 0 | 0 | 8016 | 0 | 4008 | 953.904 | $ 95.39 | 0 | $ | - |
| Incandescent Floor Lamp | Floor Lamp | 1 | 60 | 1.5 | 0 | 22.5 | 90 | 0 | 45 | 10.71 | $ 1.07 | 0 | $ | - |
| Incandescent Desk Lamp | Desk Lamp | 1 | 60 | 6.5 | 0 | 17.5 | 390 | 0 | 390 | 92.82 | $ 9.28 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 14 | 1.5 | 0 | 22.5 | 21 | 0 | 10.5 | 2.499 | $ 0.25 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 12 | 1.5 | 0 | 22.5 | 18 | 0 | 9 | 2.142 | $ 0.21 | 0 | $ | - |
| Incandescent Floor Lamp | Floor Lamp | 1 | 60 | 1.5 | 0 | 22.5 | 90 | 0 | 45 | 10.71 | $ 1.07 | 0 | $ | - |
| Alarm Clock | Clock Radio | 1 | 4 | 24 | 0 | 0 | 96 | 0 | 96 | 22.848 | $ 2.28 | 0 | $ | - |
| Microwave | Microwave | 1 | 900 | 0.12 | 1 | 23.88 | 108 | 0 | 54 | 12.852 | $ 1.29 | 0 | $ | - |
| Electronics | Camera Charger | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 48 | 11.424 | $ 1.14 | 0 | $ | - |
| Computer | Dell | 1 | 45 | 6.5 | 2 | 17.5 | 292.5 | 35 | 327.5 | 77.945 | $ 7.79 | 8.33 | $ | 0.83 |
| Television | TV | 1 | 23 | 0.75 | 1 | 23.25 | 17.25 | 23.25 | 20.25 | 4.8195 | $ 0.48 | 2.76675 | $ | 0.28 |
| Printer | Printer | 1 | 30 | 0.8 | 4 | 23.2 | 24 | 92.8 | 116.8 | 27.7984 | $ 2.78 | 22.0864 | $ | 2.21 |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 0.4 | 16 | 16 | 6.4 | 22.4 | 5.3312 | $ 0.53 | 1.5232 | $ | 0.15 |
| Overhead light | Overhead | 1 | 10 | 4.5 | 0 | 19.5 | 45 | 0 | 22.5 | 5.355 | $ 0.54 | 0 | $ | - |
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| | Total | 14 | 1556 | 105.17 | 8.4 | 230.83 | 9271.75 | 157.45 | 5214.95 | 1241.1581 | 124.11581 | 34.70635 | $ | 3.47 |

| Person 8 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Lower | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | Yes | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 600 | 24 | 0 | 0 | 14400 | 0 | 7200 | 1713.6 | $ 171.36 | 0 | $ | - |
| Electronics | External HD | 1 | 10 | 24 | 0 | 0 | 240 | 0 | 240 | 57.12 | $ 5.71 | 0 | $ | - |
| Electronics | Playstation | 1 | 37 | 0.3 | 0.4 | 23.7 | 11.1 | 9.48 | 10.29 | 2.44902 | $ 0.24 | 1.12812 | $ | 0.11 |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 13 | 9 | 0 | 15 | 117 | 0 | 58.5 | 13.923 | $ 1.39 | 0 | $ | - |
| Electronics | DVD player | 1 | 13 | 0.08 | 0.4 | 23.92 | 1.04 | 9.568 | 5.304 | 1.262352 | $ 0.13 | 1.138592 | $ | 0.11 |
| Incandescent Floor Lamp | Floor Lamp | 1 | 60 | 9 | 0 | 15 | 540 | 0 | 270 | 64.26 | $ 6.43 | 0 | $ | - |
| Alarm Clock | Clock Radio | 1 | 4 | 24 | 0 | 0 | 96 | 0 | 96 | 22.848 | $ 2.28 | 0 | $ | - |
| Microwave | Microwave | 1 | 1250 | 0.25 | 1 | 23.75 | 312.5 | 0 | 156.25 | 37.1875 | $ 3.72 | 0 | $ | - |
| Kitchen Appliance | Toaster Oven | 1 | 1000 | 0.03 | 1 | 23.97 | 30 | 23.97 | 26.985 | 6.42243 | $ 0.64 | 2.85243 | $ | 0.29 |
| Computer | Dell | 1 | 28 | 24 | 2 | 0 | 672 | 0 | 672 | 159.936 | $ 15.99 | 0 | $ | - |
| Television | TV | 1 | 66 | 1 | 1 | 23 | 66 | 23 | 44.5 | 10.591 | $ 1.06 | 2.737 | $ | 0.27 |
| Printer | Printer | 1 | 12 | 0.8 | 0.4 | 23.2 | 9.6 | 9.28 | 18.88 | 4.49344 | $ 0.45 | 2.20864 | $ | 0.22 |
| Phone Charger | Phone Charger | 1 | 1 | 8 | 0 | 16 | 8 | 0 | 8 | 1.904 | $ 0.19 | 0 | $ | - |
| Overhead light | Overhead | 1 | 10 | 4.5 | 0 | 19.5 | 45 | 0 | 22.5 | 5.355 | $ 0.54 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 14 | 7 | 0 | 17 | 98 | 0 | 49 | 11.662 | $ 1.17 | 0 | $ | - |
| Speakers | Stereo | 1 | 7 | 3 | 0 | 21 | 21 | 0 | 21 | 4.998 | $ 0.50 | 0 | | 0 |
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| | Total | 16 | 3125 | 138.96 | 6.2 | 245.04 | 16667.24 | 75.298 | 8899.209 | 2118.0117 | 211.8011742 | 10.06478 | $ | 1.01 |

| Person 8 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Same | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 550 | 24 | 0 | 0 | 13200 | 0 | 6600 | 1570.8 | $ 157.08 | 0 | $ | - |
| Computer | Dell | 1 | 28 | 7 | 0.4 | 17 | 196 | 6.8 | 202.8 | 48.2664 | $ 4.83 | 1.6184 | $ | 0.16 |
| Incandescent Floor Lamp | Standing Lamp | 5 | 100 | 6.5 | 0 | 17.5 | 3250 | 0 | 1625 | 386.75 | $ 38.68 | 0 | $ | - |
| Incandescent Desk Lamp | Desk Lamp | 1 | 60 | 6.5 | 0 | 17.5 | 390 | 0 | 195 | 46.41 | $ 4.64 | 0 | $ | - |
| Microwave | Microwave | 1 | 1162 | 0.03 | 1 | 23.97 | 34.86 | 0 | 17.43 | 4.14834 | $ 0.41 | 0 | $ | - |
| Electronics | Phone | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 24 | 5.712 | $ 0.57 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 2 | 4 | 0 | 20 | 8 | 0 | 8 | 1.904 | $ 0.19 | 0 | $ | - |
| Alarm Clock | Clock Radio | 1 | 3 | 24 | 0 | 0 | 72 | 0 | 72 | 17.136 | $ 1.71 | 0 | $ | - |
| Overhead light | Overhead | 1 | 10 | 4.5 | 0 | 19.5 | 45 | 0 | 22.5 | 5.355 | $ 0.54 | 0 | $ | - |
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| | Total | 13 | 1917 | 100.53 | 1.4 | 115.47 | 17243.86 | 6.8 | 8766.73 | 2086.4817 | 208.648174 | 1.6184 | $ | 0.16 |

| Person 10 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Lower | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 600 | 24 | 0 | 0 | 14400 | 0 | 7200 | 1713.6 | $ 171.36 | 0 | $ - | |
| Computer | MacBook | 1 | 65 | 1.5 | 0 | 22.5 | 97.5 | 0 | 97.5 | 23.205 | $ 2.32 | 0 | $ - | |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 13 | 4 | 0 | 20 | 52 | 0 | 26 | 6.188 | $ 0.62 | 0 | $ - | |
| Other | Vacuum | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 24 | 5.712 | $ 0.57 | 0 | $ - | |
| Kitchen Appliances | Blender | 1 | 1000 | 0.08 | 0 | 23.92 | 80 | 0 | 80 | 19.04 | $ 1.90 | 0 | $ - | |
| Kitchen Appliances | Food Processor | 1 | 800 | 0.05 | 0 | 23.95 | 40 | 0 | 40 | 9.52 | $ 0.95 | 0 | $ - | |
| Kitchen Appliances | Mini Food Processor | 1 | 400 | 0.167 | 0 | 23.833 | 66.8 | 0 | 66.8 | 15.8984 | $ 1.59 | 0 | $ - | |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 0 | 16 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ - | |
| Overhead light | Overhead | 2 | 60 | 3 | 0 | 21 | 360 | 0 | 180 | 42.84 | $ 4.28 | 0 | $ - | |
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| | Total | 10 | 2942 | 64.797 | 0 | 151.203 | 15160.3 | 0 | 7730.3 | 1839.8114 | 183.98114 | 0 | $ - | |

| Person 10 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Lower | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 600 | 24 | 0 | 0 | 14400 | 0 | 7200 | 1713.6 | $ 171.36 | 0 | $ | - |
| Computer | MacBook | 1 | 65 | 1.5 | 0 | 22.5 | 97.5 | 0 | 97.5 | 23.205 | $ 2.32 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 13 | 4 | 0 | 20 | 52 | 0 | 26 | 6.188 | $ 0.62 | 0 | $ | - |
| Other | Vacuum | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 24 | 5.712 | $ 0.57 | 0 | $ | - |
| Kitchen Appliances | Blender | 1 | 1000 | 0.08 | 0 | 23.92 | 80 | 0 | 80 | 19.04 | $ 1.90 | 0 | $ | - |
| Kitchen Appliances | Food Processor | 1 | 800 | 0.05 | 0 | 23.95 | 40 | 0 | 40 | 9.52 | $ 0.95 | 0 | $ | - |
| Kitchen Appliances | Mini Food Processor | 1 | 400 | 0.167 | 0 | 23.833 | 66.8 | 0 | 66.8 | 15.8984 | $ 1.59 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 0 | 16 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ | - |
| Overhead light | Overhead | 2 | 60 | 3 | 0 | 21 | 360 | 0 | 180 | 42.84 | $ 4.28 | 0 | $ | - |
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| | Total | 10 | 2942 | 64.797 | 0 | 151.203 | 15160.3 | 0 | 7730.3 | 1839.8114 | 183.98114 | 0 | $ | - |

| Person 11 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Lower | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Higher | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 500 | 24 | 0 | 0 | 12000 | 0 | 6000 | 1428 | $ 142.80 | 0 | $ | - |
| Computer | Dell | 1 | 33 | 6 | 0 | 18 | 198 | 0 | 198 | 47.124 | $ 4.71 | 0 | $ | - |
| Fluorescent Desk Lamp | Desk lamp | 1 | 30 | 0.08 | 0 | 23.92 | 2.4 | 0 | 1.2 | 0.2856 | $ 0.03 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 13 | 0.167 | 0 | 23.833 | 2.171 | 0 | 1.0855 | 0.258349 | $ 0.03 | 0 | $ | - |
| Kitchen Appliance | Toaster Oven | 1 | 1200 | 0.167 | 0 | 23.833 | 200.4 | 0 | 100.2 | 23.8476 | $ 2.38 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 5 | 60 | 2 | 0 | 22 | 600 | 0 | 300 | 71.4 | $ 7.14 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 2 | 8 | 0 | 16 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ | - |
| Overhead light | Overhead | 1 | 12 | 5 | 0 | 19 | 60 | 0 | 30 | 7.14 | $ 0.71 | 0 | $ | - |
| Alarm Clock | Clock Radio | 1 | 2 | 24 | 0 | 0 | 48 | 0 | 48 | 11.424 | $ 1.14 | 0 | $ | - |
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| | | | | | | | | | | | | | | |
| | Total | 13 | 1852 | 69.414 | 0 | 146.586 | 13126.971 | 0 | 6694.4855 | 1593.2875 | 159.3287549 | 0 | $ | - |

| Person 12 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Lower | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 500 | 24 | 0 | 0 | 12000 | 0 | 6000 | 1428 | $ 142.80 | 0 | $ | - |
| Computer | IBM | 1 | 32 | 8 | 1 | 16 | 256 | 16 | 272 | 64.736 | $ 6.47 | 3.808 | $ | 0.38 |
| Fluorescent Desk Lamp | Desk lamp | 1 | 20 | 10 | 0 | 14 | 200 | 0 | 200 | 47.6 | $ 4.76 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 100 | 10 | 0 | 14 | 1000 | 0 | 1000 | 238 | $ 23.80 | 0 | $ | - |
| Electronics | External HD | 1 | 10 | 24 | 0 | 0 | 240 | 0 | 240 | 57.12 | $ 5.71 | 0 | $ | - |
| Printer | Printer | 1 | 20 | 0.25 | 2 | 23.75 | 5 | 47.5 | 52.5 | 12.495 | $ 1.25 | 11.305 | $ | 1.13 |
| Phone Charger | Phone Charger | 1 | 3 | 7 | 0.4 | 17 | 21 | 6.8 | 27.8 | 6.6164 | $ 0.66 | 1.6184 | $ | 0.16 |
| Overhead light | Overhead | 2 | 14 | 8 | 0 | 16 | 224 | 0 | 112 | 26.656 | $ 2.67 | 0 | $ | - |
| Alarm Clock | Clock Radio | 1 | 1 | 24 | 0 | 0 | 24 | 0 | 24 | 5.712 | $ 0.57 | 0 | $ | - |
| Microwave | Microwave | 1 | 1162 | 0.03 | 1 | 23.97 | 34.86 | 0 | 17.43 | 4.14834 | $ 0.41 | 0 | $ | - |
| Television | TV | 1 | 51 | 1 | 0.4 | 23 | 51 | 9.2 | 30.1 | 7.1638 | $ 0.72 | 2.1896 | $ | 0.22 |
| Incandescent Floor Lamp | Standing Lamp | 1 | 60 | 0.5 | 0 | 23.5 | 30 | 0 | 15 | 3.57 | $ 0.36 | 0 | $ | - |
| Electronics | Sound Machine | 1 | 72 | 7 | 0 | 17 | 504 | 0 | 252 | 59.976 | $ 6.00 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 2 | 60 | 2 | 0 | 22 | 240 | 0 | 120 | 28.56 | $ 2.86 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 100 | 10 | 0 | 14 | 1000 | 0 | 500 | 119 | $ 11.90 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 1 | 26 | 0.5 | 0 | 23.5 | 13 | 0 | 6.5 | 1.547 | $ 0.15 | 0 | | 0 |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| | Total | 18 | 2231 | 136.28 | 4.8 | 247.72 | 15842.86 | 79.5 | 8869.33 | 2110.9005 | 211.090054 | 18.921 | $ | 1.89 |

| Person 13 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that at | | Higher | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 500 | 24 | 0 | 0 | 12000 | 0 | 6000 | 1428 | $ 142.80 | 0 | $ | - |
| Computer | MacBook | 1 | 38 | 12 | 1 | 12 | 456 | 12 | 468 | 111.384 | $ 11.14 | 2.856 | $ | 0.29 |
| Printer | Printer | 1 | 36 | 0.25 | 2 | 23.75 | 9 | 47.5 | 56.5 | 13.447 | $ 1.34 | 11.305 | $ | 1.13 |
| Electronics | External HD | 1 | 10 | 24 | 0 | 0 | 240 | 0 | 240 | 57.12 | $ 5.71 | 0 | $ | - |
| Phone Charger | Phone Charger | 1 | 1 | 4 | 0.4 | 20 | 4 | 8 | 12 | 2.856 | $ 0.29 | 1.904 | $ | 0.19 |
| Overhead | Overhead Light | 1 | 47 | 0.75 | 0 | 23.25 | 35.25 | 0 | 35.25 | 8.3895 | $ 0.84 | 0 | $ | - |
| Electronics | Camera Charger | 1 | 2 | 0.01 | 0 | 23.99 | 0.02 | 0 | 0.02 | 0.00476 | $ 0.00 | 0 | $ | - |
| Fluorescent Floor Lamp | Standing Lamp | 2 | 23 | 6 | 0 | 18 | 276 | 0 | 276 | 65.688 | $ 6.57 | 0 | $ | - |
| Flourescent Desk Lamp | Desk lamp | 1 | 20 | 7 | 0 | 17 | 140 | 0 | 140 | 33.32 | $ 3.33 | 0 | $ | - |
| Microwave | Microwave | 1 | 1235 | 0.25 | 1 | 23.75 | 308.75 | 0 | 154.375 | 36.74125 | $ 3.67 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 75 | 9 | 0 | 15 | 675 | 0 | 337.5 | 80.325 | $ 8.03 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 2 | 60 | 9 | 0 | 15 | 1080 | 0 | 540 | 128.52 | $ 12.85 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 100 | 2 | 0 | 22 | 200 | 0 | 100 | 23.8 | $ 2.38 | 0 | $ | - |
| Speakers | iHome | 1 | 15 | 1 | 0.4 | 23 | 15 | 9.2 | 12.1 | 2.8798 | $ 0.29 | 1.0948 | $ | 0.11 |
| Television | TV | 1 | 112 | 3 | 0.4 | 21 | 336 | 8.4 | 172.2 | 40.9836 | $ 4.10 | 0.9996 | $ | 0.10 |
| Incandescent Floor Lamp | Standing Lamp | 1 | 70 | 2 | 0 | 22 | 140 | 0 | 70 | 16.66 | $ 1.67 | 0 | | 0 |
| Kitchen Appliance | Crook Pot | 1 | 150 | 0.01 | 0 | 23.99 | 1.5 | 0 | 0.75 | 0.1785 | $ 0.02 | 0 | | 0 |
| Kitchen Appliance | Mixer | 1 | 35 | 0.25 | 0 | 23.75 | 8.75 | 0 | 4.375 | 1.04125 | $ 0.10 | 0 | | 0 |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Total | 20 | 2529 | 104.52 | 5.2 | 327.48 | 15925.27 | 85.1 | 8619.07 | 2051.3387 | 205.133866 | 18.1594 | $ | 1.82 |

| Person 14 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Room Type | Double | | | | | | | | | | | | | |
| Kitchen | Yes | | | | | | | | | | | | | |
| How does your energy use on campus compare to that | | Same | | | | | | | | | | | | |
| Do you unplug appliances/turn off surge when not in | | No | | | | | | | | | | | | |
| How do you percieve your energy use to be? | | Below | | | | | | | | | | | | |
| | | | Full On | | Idle | | Energy Consumption | | Totals per person | | | Totals | | |
| | | | Power | Usage/Day | Power | Usage/Day | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost | |
| Type | Items | Quantity | Watts | Hour | Watts | Hour | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ | |
| Refrigerator | Refrigerator | 1 | 500 | 24 | 0 | 0 | 12000 | 0 | 6000 | 1428 | $ 142.80 | 0 | $ | - |
| Computer | Dell | 1 | 0 | 0 | 0.4 | 24 | 0 | 9.6 | 9.6 | 2.2848 | $ 0.23 | 2.2848 | $ | 0.23 |
| Computer | Dell | 1 | 29 | 5 | 0.4 | 19 | 145 | 7.6 | 152.6 | 36.3188 | $ 3.63 | 1.8088 | $ | 0.18 |
| Phone Charger | Phone Charger | 1 | 1 | 4 | 0.4 | 20 | 4 | 8 | 12 | 2.856 | $ 0.29 | 1.904 | $ | 0.19 |
| Incandescent Floor Lamp | Standing Lamp | 1 | 100 | 1 | 0 | 23 | 100 | 0 | 100 | 23.8 | $ 2.38 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 60 | 0.5 | 0 | 23.5 | 30 | 0 | 30 | 7.14 | $ 0.71 | 0 | $ | - |
| Printer | Printer | 1 | 36 | 0.25 | 2 | 23.75 | 9 | 47.5 | 56.5 | 13.447 | $ 1.34 | 11.305 | $ | 1.13 |
| Bathroom Appliance | Straightner | 1 | 200 | 0.08 | 0 | 23.92 | 16 | 0 | 16 | 3.808 | $ 0.38 | 0 | $ | - |
| Bathroom Appliance | Hair Dryer | 1 | 582 | 0.08 | 0 | 23.92 | 46.56 | 0 | 46.56 | 11.08128 | $ 1.11 | 0 | $ | - |
| Microwave | Microwave | 1 | 1235 | 0.25 | 1 | 23.75 | 308.75 | 0 | 154.375 | 36.74125 | $ 3.67 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 75 | 9 | 0 | 15 | 675 | 0 | 337.5 | 80.325 | $ 8.03 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 2 | 60 | 9 | 0 | 15 | 1080 | 0 | 540 | 128.52 | $ 12.85 | 0 | $ | - |
| Incandescent Floor Lamp | Standing Lamp | 1 | 100 | 2 | 0 | 22 | 200 | 0 | 100 | 23.8 | $ 2.38 | 0 | $ | - |
| Speakers | iHome | 1 | 15 | 1 | 0.4 | 23 | 15 | 9.2 | 12.1 | 2.8798 | $ 0.29 | 1.0948 | $ | 0.11 |
| Television | TV | 1 | 112 | 3 | 0.4 | 21 | 336 | 8.4 | 172.2 | 40.9836 | $ 4.10 | 0.9996 | $ | 0.10 |
| Incandescent Floor Lamp | Standing Lamp | 1 | 70 | 2 | 0 | 22 | 140 | 0 | 70 | 16.66 | $ 1.67 | 0 | | 0 |
| Kitchen Appliance | Crook Pot | 1 | 150 | 0.01 | 0 | 23.99 | 1.5 | 0 | 0.75 | 0.1785 | $ 0.02 | 0 | | 0 |
| Kitchen Appliance | Mixer | 1 | 35 | 0.25 | 0 | 23.75 | 8.75 | 0 | 4.375 | 1.04125 | $ 0.10 | 0 | | 0 |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Total | 19 | 3360 | 61.42 | 5 | 370.58 | 15115.56 | 90.3 | 7814.56 | 1859.8653 | 185.986528 | 19.397 | $ | 1.94 |

## E. Total "Single" Room Consumption

| | | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Alarm Clock Total | 3 | 192.00 | 0.00 | 192.00 | 45.70 | $ 4.57 | 0.00 | $ - |
| Bathroom Appliance Total | 4 | 208.76 | 23.84 | 232.60 | 55.36 | $ 5.54 | 5.67 | $ 0.57 |
| Computer Total | 4 | 784.00 | 29.20 | 813.20 | 193.54 | $ 19.35 | 6.95 | $ 0.69 |
| Electronics Total | 1 | 0.24 | 23.98 | 24.22 | 5.76 | $ 0.58 | 5.71 | $ 0.57 |
| Fluorescent Desk Lamp Total | 2 | 132.50 | 0.00 | 132.50 | 31.54 | $ 3.15 | 0.00 | $ - |
| Fluorescent Floor Lamp Total | 2 | 122.00 | 0.00 | 122.00 | 29.04 | $ 2.90 | 0.00 | $ - |
| Incandescent Desk Lamp Total | 2 | 252.00 | 0.00 | 252.00 | 59.98 | $ 6.00 | 0.00 | $ - |
| Incandescent Floor Lamp Total | 5 | 1920.00 | 0.00 | 1920.00 | 456.96 | $ 45.69 | 0.00 | $ - |
| Kitchen Appliance Total | 1 | 4.55 | 0.00 | 4.55 | 1.08 | $ 0.11 | 0.00 | $ - |
| Microwave Total | 4 | 190.00 | 0.00 | 190.00 | 45.22 | $ 4.52 | 0.00 | $ - |
| Other Total | 2 | 1153.00 | 0.00 | 1153.00 | 274.41 | $ 27.44 | 0.00 | $ - |
| Overhead Light Total | 5 | 147.00 | 0.00 | 147.00 | 34.99 | $ 3.50 | 0.00 | $ - |
| Phone Charger Total | 4 | 26.00 | 54.30 | 80.30 | 19.11 | $ 1.91 | 12.92 | $ 1.29 |
| Printer Total | 2 | 1.40 | 167.86 | 169.26 | 40.28 | $ 4.03 | 39.95 | $ 4.00 |
| Refrigerator Total | 4 | 32640.00 | 0.00 | 32640.00 | 7768.32 | $ 776.83 | 0.00 | $ - |
| Speakers Total | 4 | 82.50 | 228.75 | 311.25 | 74.08 | $ 7.41 | 54.44 | $ 5.44 |
| Television Total | 3 | 712.50 | 32.50 | 745.00 | 177.31 | $ 17.73 | 7.74 | $ 0.77 |
| Grand Total | 53 | 38568.45 | 560.43 | 39128.88 | 9312.67 | $ 931.27 | 133.38 | $ 13.34 |

## F. Total "Double without Kitchen" Room Consumption

| | | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Alarm Clock Total | 2 | 168.00 | 0.00 | 168.00 | 39.98 | $ 4.00 | 0.00 | $ - |
| Bathroom Appliance Total | 2 | 114.94 | 23.83 | 138.77 | 33.03 | $ 3.30 | 5.67 | $ 0.57 |
| Computer Total | 3 | 732.50 | 55.00 | 787.50 | 187.43 | $ 18.74 | 13.09 | $ 1.31 |
| Electronics Total | 2 | 288.00 | 0.00 | 288.00 | 68.54 | $ 6.85 | 0.00 | $ - |
| Flourescent Desk Lamp Total | 2 | 147.00 | 0.00 | 147.00 | 34.99 | $ 3.50 | 0.00 | $ - |
| Flourescent Floor Lamp Total | 3 | 199.00 | 0.00 | 179.50 | 42.72 | $ 4.27 | 0.00 | $ - |
| Incandescent Desk Lamp Total | 1 | 390.00 | 0.00 | 390.00 | 92.82 | $ 9.28 | 0.00 | $ - |
| Incandescent Floor Lamp Total | 2 | 180.00 | 0.00 | 90.00 | 21.42 | $ 2.14 | 0.00 | $ - |
| Kitchen Appliance Total | 1 | 4.55 | 0.00 | 4.55 | 1.08 | $ 0.11 | 0.00 | $ - |
| Microwave Total | 2 | 188.00 | 0.00 | 94.00 | 22.37 | $ 2.24 | 0.00 | $ - |
| Overhead Light Total | 2 | 165.00 | 0.00 | 82.50 | 19.64 | $ 1.96 | 0.00 | $ - |
| Phone Charger Total | 3 | 48.00 | 22.40 | 70.40 | 16.76 | $ 1.68 | 5.33 | $ 0.53 |
| Printer Total | 2 | 24.60 | 116.78 | 141.38 | 33.65 | $ 3.36 | 27.79 | $ 2.78 |
| Refrigerator Total | 3 | 22032.00 | 0.00 | 11016.00 | 2621.81 | $ 262.18 | 0.00 | $ - |
| Speakers Total | 1 | 15.00 | 0.00 | 15.00 | 3.57 | $ 0.36 | 0.00 | $ - |
| Television Total | 1 | 17.25 | 23.25 | 20.25 | 4.82 | $ 0.48 | 2.77 | $ 0.28 |
| Grand Total | 33 | 24713.84 | 241.26 | 13632.85 | 3244.62 | $ 324.46 | 54.65 | $ 5.47 |

## G. Total "Double with Kitchen" Room Consumption

| | | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Alarm Clock Total | 4 | 240.00 | 0.00 | 240.00 | 57.12 | $ 5.71 | 0.00 | $ - |
| Bathroom Appliance Total | 2 | 62.56 | 0.00 | 62.56 | 14.89 | $ 1.49 | 0.00 | $ - |
| Computer Total | 8 | 2020.50 | 52.00 | 2072.50 | 493.26 | $ 49.33 | 12.38 | $ 1.24 |
| Electronics Total | 8 | 1284.16 | 19.05 | 1011.61 | 240.76 | $ 24.08 | 2.27 | $ 0.23 |
| Flourescent Desk Lamp Total | 3 | 342.40 | 0.00 | 341.20 | 81.21 | $ 8.12 | 0.00 | $ - |
| Flourescent Floor Lamp Total | 7 | 558.17 | 0.00 | 417.09 | 99.27 | $ 9.93 | 0.00 | $ - |
| Incandescent Desk Lamp Total | 1 | 390.00 | 0.00 | 195.00 | 46.41 | $ 4.64 | 0.00 | $ - |
| Incandescent Floor Lamp Total | 28 | 10980.00 | 0.00 | 6055.00 | 1441.09 | $ 144.11 | 0.00 | $ - |
| Kitchen Appliances Total | 9 | 437.70 | 23.97 | 324.24 | 77.17 | $ 7.72 | 2.85 | $ 0.29 |
| Microwave Total | 5 | 999.72 | 0.00 | 499.86 | 118.97 | $ 11.90 | 0.00 | $ - |
| Other Total | 1 | 48.00 | 0.00 | 24.00 | 5.71 | $ 0.57 | 0.00 | $ - |
| Overhead light Total | 7 | 769.25 | 0.00 | 402.25 | 95.74 | $ 9.57 | 0.00 | $ - |
| Phone Charger Total | 7 | 77.00 | 22.80 | 99.80 | 23.75 | $ 2.38 | 5.43 | $ 0.54 |
| Printer Total | 4 | 32.60 | 151.78 | 184.38 | 43.88 | $ 4.39 | 36.12 | $ 3.61 |
| Refrigerator Total | 7 | 90000.00 | 0.00 | 45000.00 | 10710.00 | $ 1,071.00 | 0.00 | $ - |
| Speakers Total | 3 | 51.00 | 18.40 | 45.20 | 10.76 | $ 1.08 | 2.19 | $ 0.22 |
| Television Total | 4 | 789.00 | 49.00 | 419.00 | 99.72 | $ 9.97 | 6.93 | $ 0.69 |
| Grand Total | 109 | 109082.06 | 337.00 | 57393.68 | 13659.70 | $ 1,365.97 | 68.16 | $ 6.82 |

## H. Total Room Consumption

| | | Energy Consumption | | Totals per person | | | Totals | |
|---|---|---|---|---|---|---|---|---|
| | | Power Consumed | Power Wasted | Total Daily Energy | Total Annual Energy | Total Annual Cost | Total Annual Wasted Energy | Total Annual Wasted Cost |
| | Quantity | Watt-Hours | Watt-Hours | Watt-Hours | kWh | $ | kWh | $ |
| Alarm Clock Total | 9 | 600.00 | 0.00 | 600.00 | 142.80 | $ 14.28 | 0.00 | $ - |
| Bathroom Appliance Total | 8 | 386.26 | 47.67 | 433.93 | 103.28 | $ 10.33 | 11.35 | $ 1.13 |
| Computer Total | 15 | 3537.00 | 136.20 | 3673.20 | 874.22 | $ 87.42 | 32.42 | $ 3.24 |
| Electronics Total | 11 | 1572.40 | 43.03 | 1323.83 | 315.07 | $ 31.51 | 7.97 | $ 0.80 |
| Fluorescent Desk Lamp Total | 7 | 621.90 | 0.00 | 620.70 | 147.73 | $ 14.77 | 0.00 | $ - |
| Fluorescent Floor Lamp Total | 12 | 879.17 | 0.00 | 718.59 | 171.02 | $ 17.10 | 0.00 | $ - |
| Incandescent Desk Lamp Total | 4 | 1032.00 | 0.00 | 837.00 | 199.21 | $ 19.92 | 0.00 | $ - |
| Incandescent Floor Lamp Total | 35 | 13080.00 | 0.00 | 8065.00 | 1919.47 | $ 191.94 | 0.00 | $ - |
| Kitchen Appliances Total | 11 | 446.80 | 23.97 | 333.34 | 79.33 | $ 7.93 | 2.85 | $ 0.29 |
| Microwave Total | 11 | 1377.72 | 0.00 | 783.86 | 186.56 | $ 18.66 | 0.00 | $ - |
| Other Total | 3 | 1201.00 | 0.00 | 1177.00 | 280.13 | $ 28.01 | 0.00 | $ - |
| Overhead Light Total | 12 | 1081.25 | 0.00 | 631.75 | 150.36 | $ 15.04 | 0.00 | $ - |
| Phone Charger Total | 14 | 151.00 | 99.50 | 250.50 | 59.62 | $ 5.96 | 23.68 | $ 2.37 |
| Printer Total | 8 | 58.60 | 436.42 | 495.02 | 117.81 | $ 11.78 | 103.87 | $ 10.39 |
| Refrigerator Total | 14 | 144672.00 | 0.00 | 88656.00 | 21100.13 | $ 2,110.01 | 0.00 | $ - |
| Speakers Total | 8 | 148.50 | 247.15 | 371.45 | 88.41 | $ 8.84 | 56.63 | $ 5.66 |
| Television Total | 8 | 1518.75 | 104.75 | 1184.25 | 281.85 | $ 28.19 | 17.43 | $ 1.74 |
| Grand Total | 190 | 172364.35 | 1138.69 | 110155.41 | 26216.99 | $ 2,621.70 | 256.20 | $ 25.62 |